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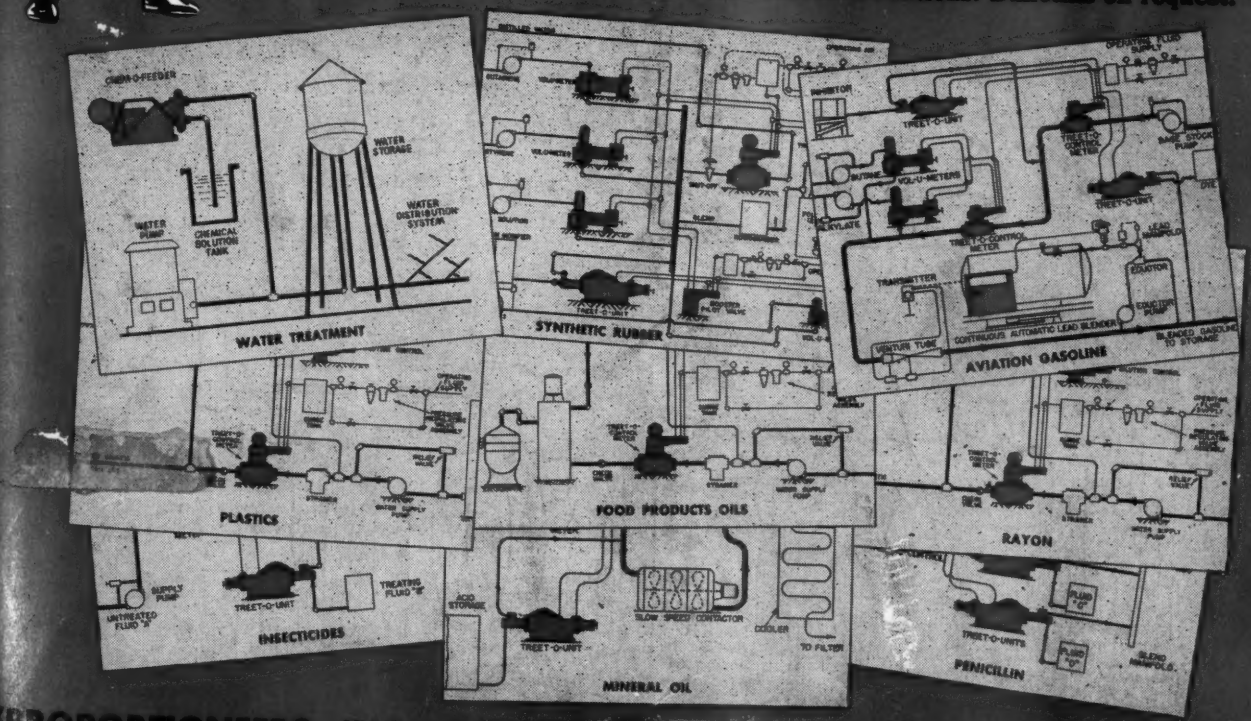

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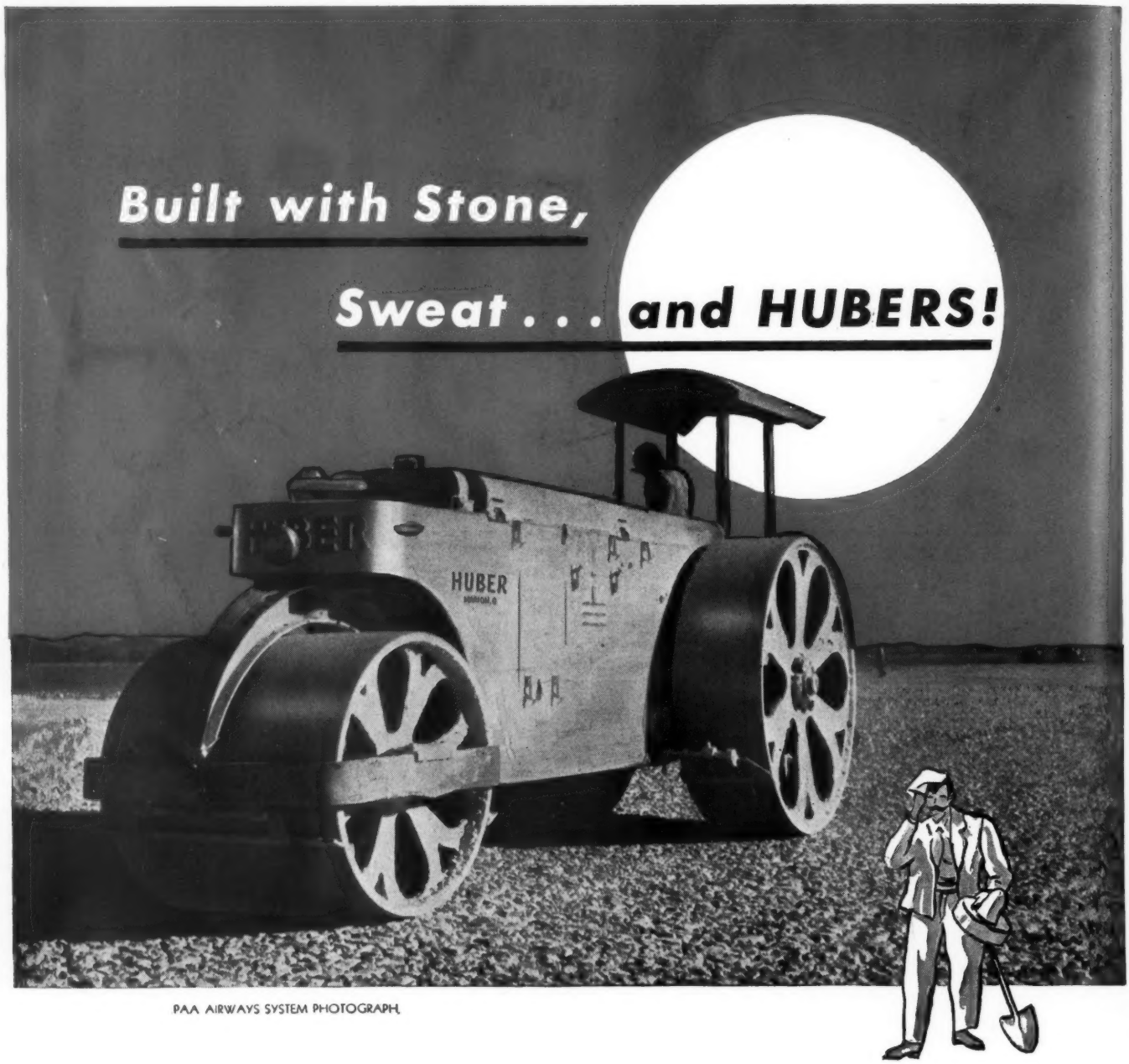

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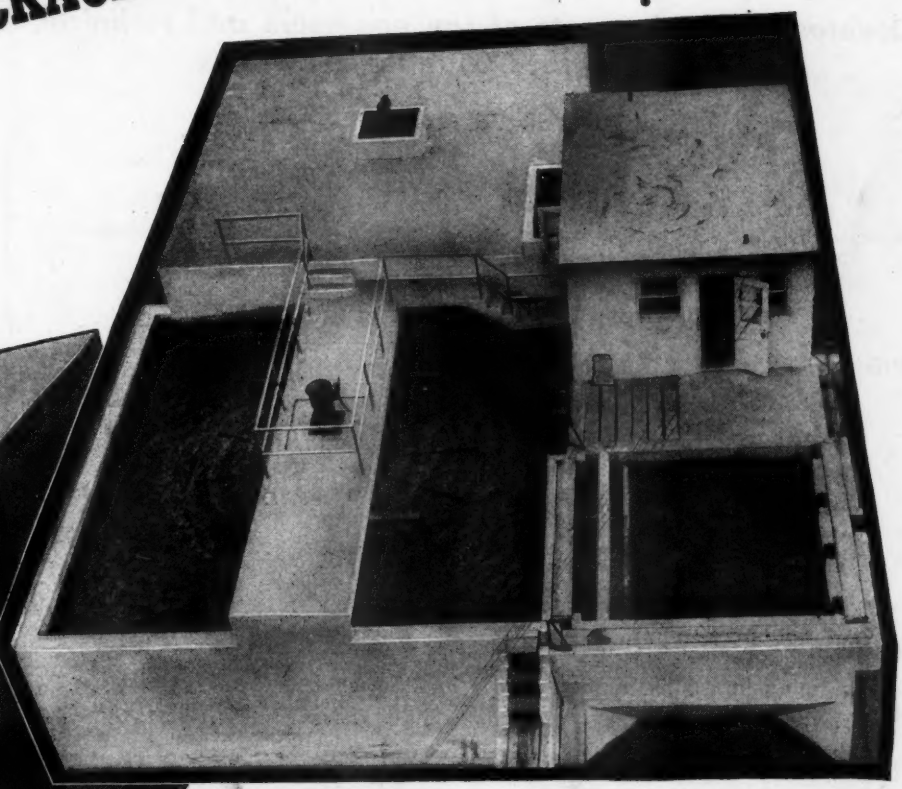

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Entered as second-class matter at the Post Office at New York, N. Y., Sept. 1, 1939, under the act of March 3, 1879. Published monthly by PUBLIC WORKS JOURNAL CORPORATION, 310 East 45th St., New York 17, N. Y. Subscription Rates: U. S. A. and Possessions, Mexico and Cuba, $3.00; Canada, $3.50. All other countries, $4.00.

MAY, 1945

PUBLIC WORKS

Founded in 1896

Devoted to the interests of the engineers and technical officials of cities, counties and states

Vol. 76 No. 5

A. PRESCOTT FOLWELL, Editor

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Published monthly by PUBLIC WORKS JOURNAL CORPORATION

Editorial and advertising offices: 310 East 45th St., New York 17, N. Y.

J. T. Morris, *President;* Croxton Morris, *Treasurer;* A. Prescott Folwell, *Secretary. Advertising representatives:* New York: Arthur K. Akers, *Advertising Manager;* Chicago: Lewis C. Morris, 612 No. Michigan Ave., Chicago 11, Ill. Subscription Rates: U.S.A. and Possessions, Mexico and Cuba, $3.00; Canada, $3.50. All other countries, $4.00. Single Copies, 35 cents each except issues containing book-length texts, which are $1.00 apiece.

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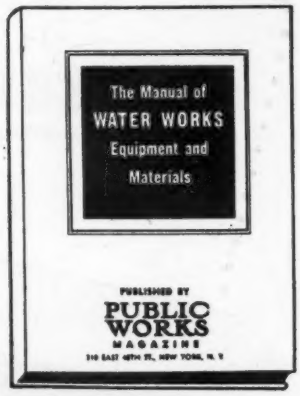

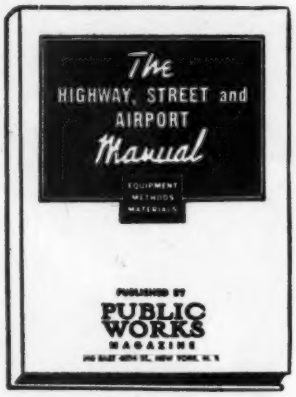

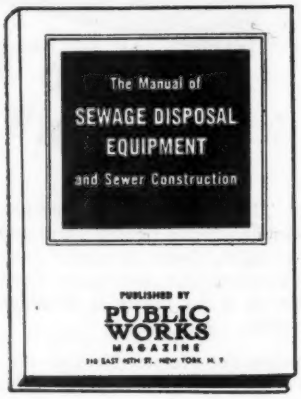

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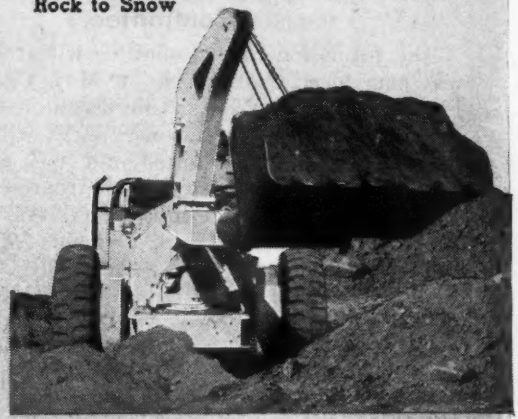

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WAR and POSTWAR EMERGENCIES

Steel Pipe for Water Utilities Restricted

As in the case of steel for sewage plants, a restriction has been placed on steel pipe for water utilities for the second quarter. This restriction was announced in Dir. 4 to Order U-1 on Mar. 28. While the limitation does not apply to any utility which will use less than 10 tons in the quarter, the direction limits the utility to ordering not more than 20 per cent more steel pipe than was used for maintenance and minor plant additions in 1944. Appeal can be made for exception to this limitation, if necessary.

Surplus Construction Machinery

The office of Surplus Property has been transferred from the Treasury Procurement Division to the Dept. of Commerce so as to place the disposal of surplus property under "a parent agency whose basic functions are closely associated with the commercial and industrial life of the nation." The Dept. of Commerce will handle construction machinery, trucks and automobiles among other commodities. Present procedures for the disposal of surplus vehicles and farm machinery will probably be changed to provide for sale direct to farmers and veterans; at present it is sold only to equipment distributors.

Simplified Practice for Clay Pipe

The clay pipe industry is proposing to adopt a program, when WPB limitation order L-316 expires, reducing the number of items they will manufacture from more than 1500 to 519. A Clay Pipe Industry Simplification Committee, with W. E. Robinson as chairman, has been preparing the details, with the cooperation of the Simplified Practice Division of the Dept. of Commerce, from which copies of the proposed program can be obtained. (Address National Bureau of Standards, Washington 25, D. C.)

A basic change is that of giving extra-strength clay pipe the same external diameter as standard strength. Both standard and extra strength will be made in the same sizes as now from 4″ to 36″ inclusive.

Public Works Construction Advisory Committee

The formation of a committee with the above title was announced April 25th by Maj. Gen. Philip B. Fleming, Federal Works Administrator. Col. William N. Carey, chief engineer of F.W.A., will act as contact between the committee and the administrator. The following organizations are represented on the committee: American Public Works Ass'n, Am. Soc. of Civil Engineers, U. S. Chamber of Commerce, Producers' Council, Assoc. General Contractors of America, Am. Ass'n of Highway Officials, Am. Soc. of Mechanical Engineers, Am. Municipal Ass'n, and Am. Institute of Architects. Invitations have been sent to the Am. Federation of Labor and the U. S. Conference of Mayors to select members to serve on the Committee.

Forests as Memorials

The idea of establishing community forests as memorials to soldiers and sailors has spread to almost every state, and many state and local groups and societies have begun such projects. These include the state planning boards of Pennsylvania, Michigan, Oklahoma and Kentucky and sectional forestry societies in Connecticut, Ohio, Massachusetts and Pennsylvania; and locally, such organizations as Rotary Clubs.

In several States statutes already are in effect permitting the acquisition and operation of such forests by municipalities or other legal subdivisions, such as school districts. The Forest Service has prepared a complete list of suggestions for the establishment and maintenance of community or memorial forests, and this will be mailed free upon request to the Forest Service, U. S. Department of Agriculture, Washington 25, D. C., or to any regional office of the Service.

Sanitary Engineers in War and Peace

As a result of the war, the Federal Service has obsorbed over 1500 sanitary engineers who formerly were employed by states, counties, cities or private industries (more than 40% of all the sanitary engineers in the country). The Sanitary Corps of the Army includes over 900 sanitary engineer commissioned officers. During the war the U. S. Public Health service has expanded its Reserve Corps to include several hundred sanitary engineers who are assigned to duty at home and abroad on malaria control, typhus fever, and sanitation programs in war areas.

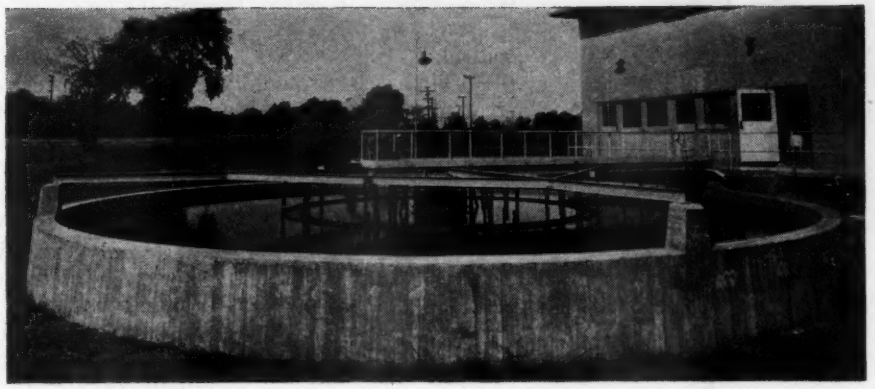
This leaves most, probably all, state, county and city health boards shorthanded, as well as municipal water and sewerage utilities. Unfortunately there will be little if any relief of this condition for some time after the end of the European war or even the Pacific one. A permanent Army Sanitary Corps of several hundred sanitary engineers may be kept in Europe in connection with our occupation of Germany and aid in re-establishment of normal peace conditions in other countries, as well as with the Army in Asia and the Pacific islands.

Dr. Haven Emerson has stated that 1170 local health jurisdictions are needed to serve the United States, and that there should be at least one sanitary engineer for each 50,000 persons, or a minimum of 2,600 in all. Add to this the state boards of health, the municipal sewerage and water utilities, staffs of consulting sanitary engineers and manufacturers of sewage and water treatment equipment, and it is seen that a return to their previous positions of all the sanitary engineers withdrawn by war emergencies would still leave a requirement for many additional ones. Moreover, the Surgeon General of the U.S.P.H.S. has said that there is need for nearly 5,000 new water systems and 10,500 new or more adequate sewerage facilities; each of which will require the services of one or more sanitary engineers.

What is being done and proposed in an effort to meet this need will be told in detail in our next issue.

PUBLIC WORKS Magazine . . . May, 1945

VOL. 76 NO. 5



A Dorrco "Hydro-Treator" 30 ft. diameter in which 3 mgd is mixed, flocculated and clarified in a single tank.

Pretreatment of Water for Effective Filtration

The principles of coagulation, and the use and control of coagulants. Reasons and equipment for rapid mixing and flocculation. Calculating the detention period of sedimentation tanks.

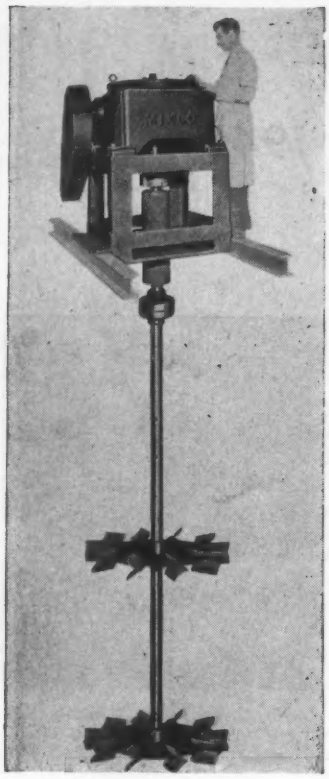
By C. R. COX

Chief, Bureau of Water Supply, New York State Dept. of Health

PRETREATMENT of water in the broad sense applies to any treatment process which precedes filtration. Therefore it embraces the preparation of water for filtration through coagulation and sedimentation; prechlorination for the purpose of disinfection; taste and odor-control procedures consisting essentially of copper sulphate treatment for algae control in reservoirs, aeration to dissipate volatile taste and odor-producing compounds and to add oxygen to water, the application of activated carbon to adsorb taste and odor-producing compounds, the practice of chloramination to prevent in so far as possible the formation of chlorinous compounds having objectionable tastes, superchlorination or breakpoint chlorination to destroy taste and odor-producing compounds through the oxidizing action of chlorine; and finally, lime-soda softening.

This discussion, however, will be restricted to the preparation of water for filtration through coagulation and sedimentation. It so happens, however, that many of the other processes enumerated are beneficial in this connection and in fact can be deliberately used to improve coagulation. For instance prechlorination with adequate doses will coagulate iron and manganese compounds, which frequently are combined with organic matter in the form of color and which are difficult to remove by aeration or coagulation at ordinary pH values. Prechlorination also will prevent or minimize the growth of organisms which otherwise might lead to the decomposition of the sludge in coagulation basins leading to secondary taste and odor problems, and also will prevent the growth of "slime" organisms on filter beds. In fact, this latter advantage is one of the chief reasons for prechlorination. The oxidizing effect of chlorine, however, is not available when the chlorine is combined with ammonia.

Some taste and odor control procedures, such as aeration and copper sulphate treatment, usually do not influence coagulation and sedimentation except when copper sulphate treatment removes algae which otherwise might interfere with coagulation through the development of a fragile floc which does not settle read-



Large size turbine-type flash mixer. Mixing Equipment Company.

ily. Inasmuch as copper sulphate applied to reservoirs does not remain in the water reaching treatment plants, any secondary benefits in coagulation basins would require the direct application of this chemical to the mixing basin influent, unless prechlorination is practiced for algae control.

Activated carbon treatment usually improves coagulation, especially of relatively clear waters, because the carbon particles act as nuclei for the formation of floc. The presence of carbon in the water also tends to reduce algae growths in open sedimentation basins by preventing the penetration of light. Activated carbon also stabilizes the sludge in such basins and thus tends to prevent secondary tastes and odors.

Superchlorination has the same inherent advantages as prechlorination but, because of the higher chlorine doses, more complex organic matter is oxidized, usually resulting in the coagulation of the organic matter so that secondary benefits accrue.

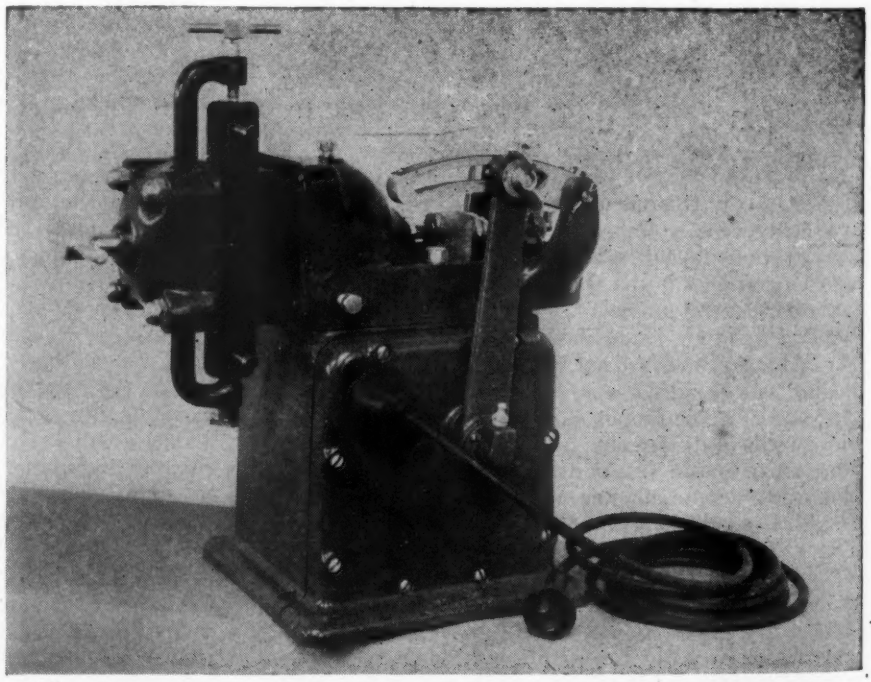
Lime-soda softening is an important pretreatment process, which is based upon the change of soluble minerals to insoluble compounds, which are coagulated and removed by sedimentation and filtration. The principles involved are similar to those governing coagulation of turbid and colored waters, but the details of application constitute a subject by itself.

Principles of Coagulation

The coagulation of water involves many complex physical-chemical reactions which are influenced by many factors. The most important factor is the character of the water involved, because even soft waters of low organic content are very complex dilute solutions of a number of elements and compounds, the presence of which is disclosed only partly by conventional analytical procedures. In so far as water purification is concerned, however, the principles of coagulation may be viewed from the standpoint of successive steps in the process. First, a coagulant such as filter alum or aluminum sulphate reacts with natural minerals in the water or an alkali added for the purpose to form a supersaturated solution of aluminum hydroxide. This supersaturated solution is formed because the solubility of aluminum hydroxide is very low at appropriate pH values. As a result, the aluminum hydroxide present in excess of the solubility value precipitates to form minute crystals. Upon gentle agitation these crystals become attached in chains or fragile networks. Finally, with continued gentle agitation these microscopic clusters of crystals form larger aggregations until visible floc is formed. This floc has a large surface area and a positive electrical charge due to complex ionic factors, and thus has the power to absorb and enmesh suspended solids, bacteria and some negative ions, because these have negative charges. The water between the specks of floc thereupon becomes practically clear and free of suspended solids. Therefore when the floc is allowed to settle in sedimentation basins the coagulated and settled water is practically clear and should have a turbidity less than 5-10 p.p.m. when treatment is effective.

The only exception to the above general statement is when colored waters are coagulated. The natural coloring matter in water incidental to leaching from forest areas, etc., is not in solution as appears to be the case, but the coloring matter is present as very minute globules of liquid coloring matter dispersed in the water as a colloidal emulsion. These globules are negatively charged and thus repel each other until their charge is neutralized and the minute globules or color colloids become attached to the positive floc. This occurs, however, only with waters of moderate color, because highly colored soft waters have been found to coagulate at low pH values, when conditions are such that basic sulphates, rather than aluminum hydroxide, are formed. Basic sulphates apparently react directly with the color colloid to form "color floc." This explains why highly colored waters coagulate best with alum in the pH range of 4.4 to 6.0, whereas turbid waters are coagulated with alum in the pH range 5.7 to 8.0.

The same general principles apply to other coagulants than filter alum, but space limitations prevent



Wallace & Tiernan Hypochlorinator, electric motor drive, proportions dose to amount of water being treated.

a more detailed discussion in this article.

It is evident from the above, therefore, that the process of coagulation consists of three steps, which in turn necessitates the provision of facilities at treatment plants favorable for these processes. First, there is the need for rapid distribution of the coagulants throughout the raw water being treated so that the resulting reaction will occur in all portions of the treated water. This preliminary mixing and distribution of the coagulant is secured by the process of "flash mixing." The second step consists in the gentle agitation of the mixed water so that the minute crystals will be agglomerated into floc. This agitation process frequently is called mixing, but this is incorrect as it should be termed "flocculation" or "conditioning" in distinction from the initial mixing required to distribute the added coagulant. The third and final step consists in sedimentation of the floc formed in the flocculation or conditioning basin so that the coagulated material will be removed from the water in so far as this can be accomplished by sedimentation.

Beckman pH meter, Industrial model, National Tech. Laboratories.

Recently a number of commercial units have been developed which utilize the improved coagulation which results when the raw water, the coagulant, and previously precipitated floc are agitated together under conditions favoring contact surface action. Some of these units also include sedimentation facilities where a heavy mass of floc produced by the above process collects in the form of a so-called "sludge blanket," through which the coagulated water rises vertically upward to skimming weirs. The rate of rise of the water is less than the rate of sedimentation of the heavy floc, b at some intermediate level the two rates are the same so that the floc remains in suspension and serves as a straining medium to catch fine floc which otherwise might escape from the basin, and also to complete any delaying coagulation by providing contact surfaces on which further crystallization and adsorption may occur.

Application of Coagulants. Coagulants and alkalis are applied to water supplies through the use of one of a number of commercial chemical feeders designed to meet specific conditions. Generally speaking chemical feeders are of three types, namely, solution feeders designed for applying solutions of the coagulant in controlled quantities to the water being treated; dry feed units designed for measuring the powdered or granular coagulant on a volumetric basis, which material usually then is dissolved in a small volume of water which carries the coagulant to the water being treated; and the third type, which applies a dry powdered or granular coagulant on the basis of weight rather than volume. All three types of feeders may be purchased for manual control, whereby the dose is constant until deliberately modified; or in automatic types, which are controlled by suitable metering devices so as to adjust the dose of coagulant in proportion to the amount of water being treated. Reference is made to the literature of the various manufacturers of chemical feeders for detailed information.

The effective operation of chemical feeders necessitates cleanliness and proper maintenance of the units. This is facilitated when chemicals are stored in separate bins or rooms above the room that houses the chemical feeder and when the units are so located that the chemical solutions need not be piped in solution hose for appreciable distances. It is especially necessary for solution hose to be accessible for cleaning and that it be so supported that serious sagging does not occur which would lead to the accumulation of insoluble residue in the solution hose.

The Control of Coagulation. The control of coagulation is based upon the addition of a sufficient dose of a coagulant to provide the aluminum hydroxide or ferric hydroxide or color floc at a resulting pH value where these compounds are least soluble. Therefore, the choice of a coagulant depends upon the various factors discussed below and the character of the water being coagulated. Ordinarily, alum is effective with most natural waters, but chlorinated copperas or one of the ferric coagulants have valuable properties when waters of high or low pH are involved, as contrasted to the pH zone of 6.5 to 7.8 of most natural waters. This is especially the case when iron and manganese removal is involved.

The required dose of coagulant is approximately proportional to the degree of turbidity or color of the water being treated, but it should be borne in mind that the actual dose required will depend upon the temperature, organic content and mineral content of the water in addition to the concentration of suspended solids being coagulated. Therefore, in the last analysis the most appropriate coagulant to use and the required dose of coagulant should be determined by jar tests, using one of the laboratory mixers.

Jar Tests. The original jar tests consisted of placing raw water in a series of quart fruit jars to which varying doses of alum or some other coagulant were added, which jars were then shaken or the water was stirred with glass rods and the resulting formation of floc was observed. Unreliable results were secured in this way because the degree of agitation could not be controlled. Laboratory mixing equipment therefore is available for this purpose or can be made by most mechanics.

The use of this equipment may be illustrated in connection with alum coagulation. Stock solution of filter alum may be prepared for convenient use by adding 17.1 grams of the chemical to one liter of distilled water. Each milliliter of this solution when added to one liter of the raw water being tested will give an alum dose of 1/1000 of the strength of the stock solution, or 17.1 p.p.m., which is one grain per gallon. Therefore trial alum doses of 1, 2, 3, etc., grains per gallon can be added to a series of one-liter

Graver Chemical Proportioner.

samples of raw water in beakers by adding with a pipette 1, 2, 3, etc. ml. of the stock solution.

The same weight, namely 17.1 grams, of any other solid coagulant would be added to distilled water to form a stock solution of that coagulant, because any differences between the various coagulants or any variation incidental to impurities in any one coagulant also would govern the use of the same material on a plant scale.

As stated elsewhere, the laboratory mixing equipment would be operated at the speeds and for the flocculation periods which trial-and-error has disclosed most closely parallel full-scale plant conditions. Obviously the smallest coagulant doses which produce good floc formation and a flocculated water which filters clear through laboratory filter paper, would represent the dose which should be used on a plant scale. Minor adjustments thereafter may be necessary to compensate for other factors due to full-scale plant conditions.

Filter alum or aluminum sulphate is in general use for the coagulation of water. Formerly copperas or ferrous sulphate was used with lime. More recently ferric sulphate has been used almost exclusively; ferric chloride is not in general use as yet for the treatment of water.

These coagulants are acid compounds and form the insoluble floc-forming compounds desired by reaction with the alkaline minerals present in natural waters or added in the form of lime or soda ash. Sodium aluminate, however, is an alkaline compound and is used with alum for coagulation at high pH values.

Properties of Coagulants

The properties of the various common coagulants are summarized in the following notes.

Alum. Most turbid and moderately colored waters in the pH range of 5.7 to 8.0 may be coagulated with alum. Highly colored waters coagulating in the pH range of 4.4 to 6.0 either require an excessive dose of alum to produce these low pH values or else sulphuric acid should be used to depress the pH value and add the sulphate ion required for effective coagulation of coloring matter. The alternate is to use heavy prechlorination with alum to oxidize iron and manganese associated with most coloring matter and also to modify the physical character of the coloring matter, thus favoring alum coagulation at normal pH values. Alum also will form calcium aluminate floc in connection with lime-soda softening at pH values of 9.0 to 10.5.

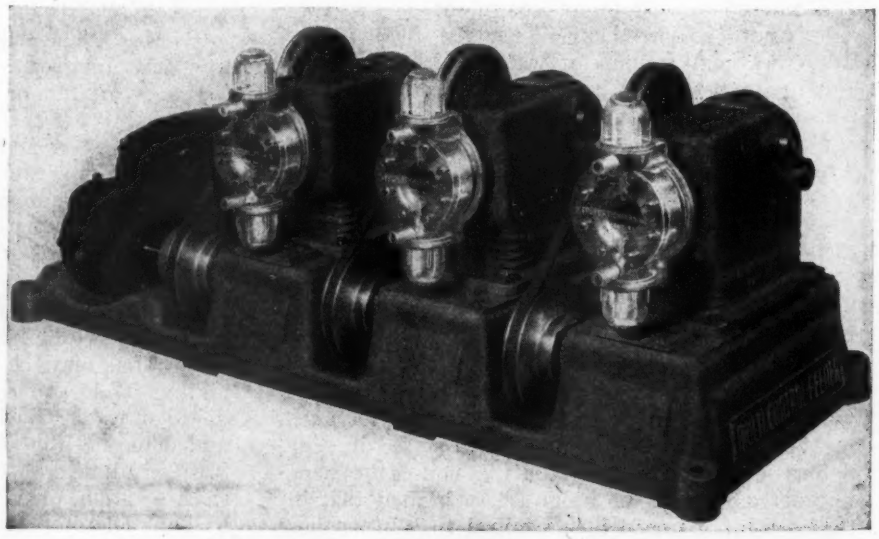
"Black Alum". This represents filter alum to which activated carbon has been added in quantities of 2% to 5% by weight so as to secure coagulation and taste and odor removal through the use of a single compound. An additional dose of activated carbon may be needed for effective taste and odor control for some waters.

"Activated Alum". This is a phrase referring to a brand of alum containing less water of crystallization than typical filter alum and also insoluble silica to aid in the coagulation of clearer waters.

Ammonium Alum. Ammonium alum is more costly and less satisfactory than filter alum, but is used in connection with "alum pots" installed with antiquated pressure filter installations. This is due to the fact that ammonium alum is less soluble than filter alum and hence dissolves more slowly when placed in alum pots. Alum pots, however, should be replaced by chemical feeders, so the required dose of filter alum may be added accurately.

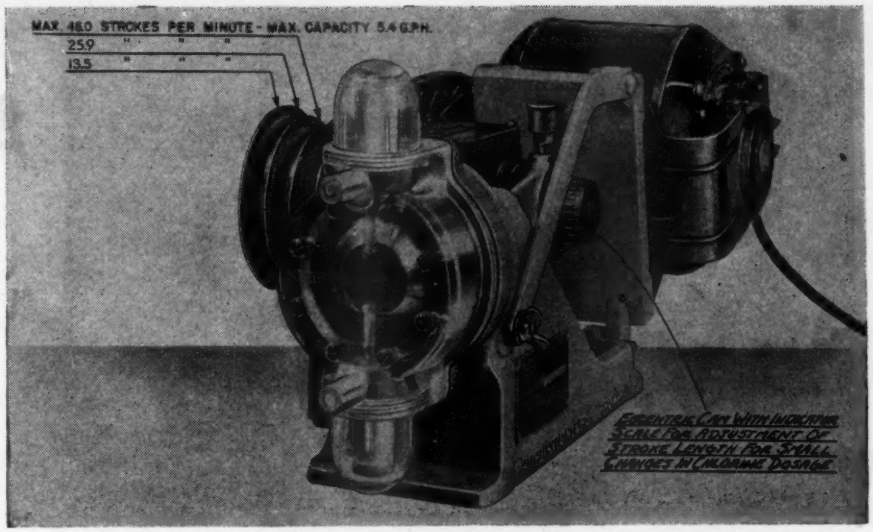
Sulphuric Acid. Sulphuric acid is dangerous to handle and is used only as an aid in the coagulation of soft, colored waters with alum where the use of the acid is more economical than an equivalent larger dose of alum alone. Commercial sulphuric acid is usually 66° Baume, which is equivalent to 93% strength. The material is shipped in 10-gallon glass carboys or drums holding 50 to 500 pounds. Concentrated acid may be stored in iron tanks and conducted through iron pipes. The *dilute* acid however, is very corrosive and must be stored in glazed earthware vessels, rubber lined steel tanks, etc. *Sulphuric acid must be diluted by adding the acid* to the water and *not* the water to the acid; otherwise violent sputtering will occur with danger of acid burns, etc. When so diluted it may be applied to water supplies through the use of small hypochlorinators or other solution feeders. A dose of about 0.2 g.p.g. usually is sufficient.

Sodium Aluminate. Sodium aluminate is not used alone as a coagulant but is used at times with alum when cold or nearly clear waters are difficult to coagu-



%Proportioneers% triplex multi-control feeder.

late. A dose of about 0.2 g.p.g. of sodium aluminate with alum usually is sufficient. This chemical also is useful in connection with double coagulation of highly colored waters, which coagulate best at low pH value. The first step consists of the addition of alum alone or alum and sulphuric acid to the influent of a primary basin. Water so coagulated, however, contains an undesirable concentration of soluble alumina (free alum) so that sodium aluminate (and also lime, if necessary) is added to increase the pH value so as to form aluminum hydroxide floc in the second basin, this usually occurring at pH of about 6.5. A third use of sodium aluminate is in connection with the lime-soda softening of turbid waters where an added coagulant is necessary for satisfactory results.

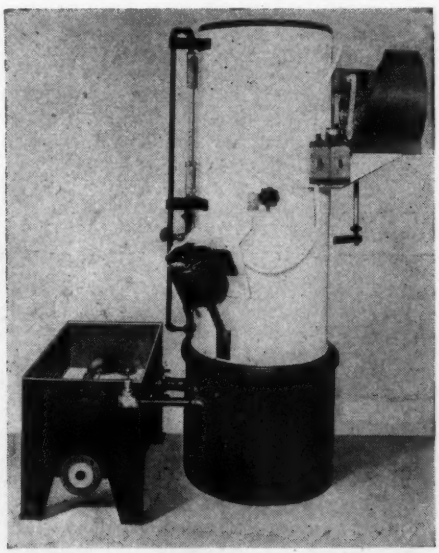


%Proportioneers% Midget Chlorofeeder.

Copperas. Ferrous sulphate or copperas will not coagulate natural waters because the reaction involves oxidation at pH values over 8.5. It is necessary, therefore, to add lime with copperas to produce the desired ferric hydroxide floc. For these reasons, this coagulant is not used in color removal, but has been used quite extensively with lime-soda softening, although the trend is towards improved softening reactions which result in effective flocculation without an added coagulant being needed. The amount of lime required to react with copperas varies with different waters but is approximately 0.27 grain per gallon for each one grain per gallon of copperas.

Chlorinated Copperas. The reaction between copperas and chlorine results in the formation of ferric sulphate and ferric chloride over a wide range of pH values. This treatment procedure, therefore, would meet those conditions where ferric coagulants are most effective.

Theoretically, one pound of chlorine reacts with 7.8 pounds of copperas but somewhat higher doses of chlorine are justified. This treatment procedure is facilitated by the ease of applying copperas and chlorine as contrasted to ferric coagulants. The dose of chlorine required for disinfection would be added in excess of that required to react with the copperas.



Omega "Universal" feeder, with automatic proportioning equipment, motor-driven agitators, rotameter and make-up tank with centrifugal pump.

Ferric Sulphate. Ferric sulphate may be purchased as an anhydrous material which may be shipped and stored in wooden barrels. The material dissolves most readily in a limited quantity of warm water, so special chemical feeders should be used whereby two parts of water are used to dissolve each part of ferric sulphate to produce a solution of about 40% strength. This is equivalent to about 3 1/3 pounds of ferric sulphate per gallon of the solution formed.

Ferric Chloride. Three commercial forms of ferric chloride are available, namely, the liquid; the crystalline, containing water of crystallization; and the anhydrous material. Liquid ferric chloride is very corrosive and must be shipped in rubber-lined tanks or small glass carboys. The strength varies from 31 to 45 per cent ferric chloride by weight, depending upon temperature. The crystalline form of the material contains 60% ferric chloride by weight and is shipped in barrels holding about 435 pounds. The anhydrous material is shipped in drums holding about 100 pounds and remains non-corrosive only so long as moisture is excluded from the drums. When the drums are open, therefore, the entire content must be dissolved in the water at one time.

Adsorptive Clay. Bentonite, Fuller's earth and similar clays have been used in recent years to assist in the coagulation of water, although their use is not so well established as that of the coagulants outlined above. As stated previously, however, these adsorptive clays may assist in the coagulation of relatively clear waters by supplying suspended material to aid in floc formation, although some clays swell when added to water and produce a floc of themselves. Some of the adsorptive clays remove taste and odor-producing substances, especially those of an oily nature.

Sodium Silicate. Colloidal or activated silica is being used as an aid to coagulation in accordance with four patented procedures. One process involves the partial neutralization of sodium silicate with sulphuric acid to produce the colloidal silica, which is added to the raw water before alum or ferrous sulphate is applied. Another process involves the reaction between sodium silicate and alum or ferrous sulphate as complete coag-

(Continued on page 46)

Underdrainage system, before removing nozzles from manifold trunk.

A Filter Problem

By FRANK D. BEHAN

THIS article is an attempt to explain to small-plant operators (like myself) the unwholesome condition that existed at our filter plant and the steps we took to eliminate it. The condition described may be more or less common but we believe we were the first municipal plant in the state to have a complete installation such as is described below. The installation included anthrafilt filter medium and Palmer filter bed agitators; and this, with the use of activated alum as coagulant, has proven most satisfactory.

Description of the Plant

Our plant was constructed in 1936 as a PWA project at a cost of approximately $65,000, and placed in operation during the fall of that year. Our supply is derived from three brook-fed impounding reservoirs about five miles west of the plant, which have a total capacity of 530 mg. From these the water is brought by two cast iron mains, one of 12″ c.i. pipe, the second of 12″ for the upper half and 16″ for the lower. These two mains are cross-connected at mid-length, and a 12″ Universal pipe, connected to the cross-connection, permits using an emergency supply pumped from the Saranac river.

At the plant the two lines combine into a 20″ pipe, in which is a Venturi meter, which discharges into a mixing chamber equipped with a variable-speed mechanical agitator, retention time about 15 minutes. From this the water enters an around-the-end baffle chamber with a retention of 25 minutes, and then into a covered sedimentation basin, retention 3 hrs. (Retention periods are based on 4.15 mgd.)

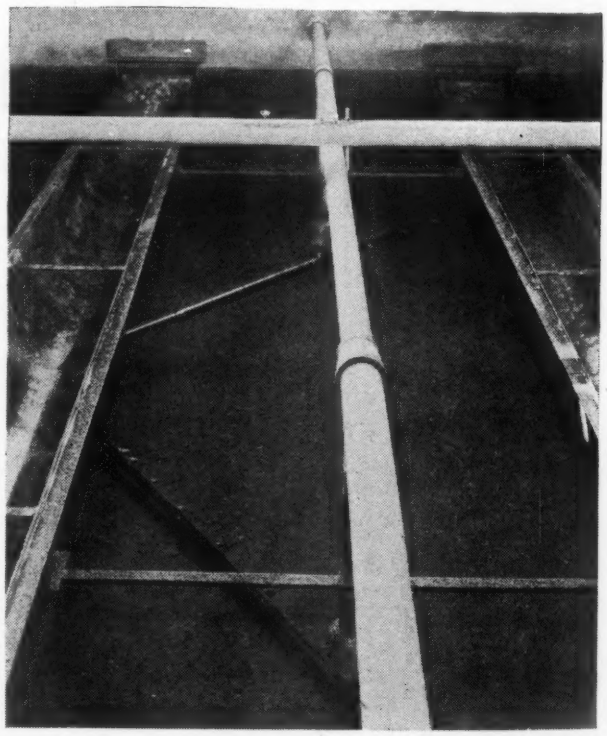
There are six gravity rapid sand filters, capacity 4.15 mgd at 2 gpm per sq. ft. of filter area. The filter tanks are of reinforced concrete, 20 x 12 ft., each containing two steel wash water troughs with 24″ freeboard. The underdrainage is of the Harrisburg type, a c.i. split manifold with 80 nozzles on the top and 40 2″ laterals at right angles on each side; the laterals being about 5 ft. long and perforated on the bottom side, with a ¼ in. air vent drilled in the top of each lateral at the wall end. Filter effluent passes through venturi direct-acting rate controls and thence into two reinforced concrete open distribution reservoirs of 2.3 mg and 2.7 mg capacity. Also the filters are equipped with loss-of-head gauges and manually operated control valves and an hydraulic valve on the supply line just ahead of the mixing chamber. There are three manual control, vacuum type chlorinators and three dry-feed chemical machines, all W & T make. The laboratory is equipped for routine physical and chemical analyses. The filter sand was specified to be Cape May or equal, effective size 0.44 to 0.46 mm, uniformity coefficient 1.5 to 1.8; 24″ of this to be supported on 18″ of gravel ranging in size from 3″ to 1/16″.

For washing the filters there was a 3,600 gpm Cameron centrifugal pump, this amount giving a 24″ vertical rise at 40 lb. pressure. This pump draws by submerged suction from the 20″ filter effluent pipe. The waste drain and wash-water troughs are of such size and gradient that 3,600 gpm is their maximum capacity. This and the fact that the drain was laid under the entire plant, including the coagulation basins, had to be considered in planning the improvements.

After six years of operation the filters became loaded with mud balls to the point where hand raking during excessively long wash periods failed to break them up. Boiling action was very noticeable; sand was pulled away from the walls, and in general the filters were in a mess.

In February 1943 our former operator left and the operation of the plant was turned over to me, as Assistant Superintendent of Public Works, although I had no knowledge of filtration other than the fact that we had a filter plant.

Two months later, in April, the spring break-up arrived and with it, color and turbidity. We asked for assistance from the district sanitary engineer of the



Feed line supported by U-bolt from 3″ pipe and grouted in back wall.

nd How it was Solved

Formation of mud balls and rapid clogging of filters was not prevented by longer wash periods at maximum washing rates. Trouble was eliminated by use of anthrafilt and filter agitators.

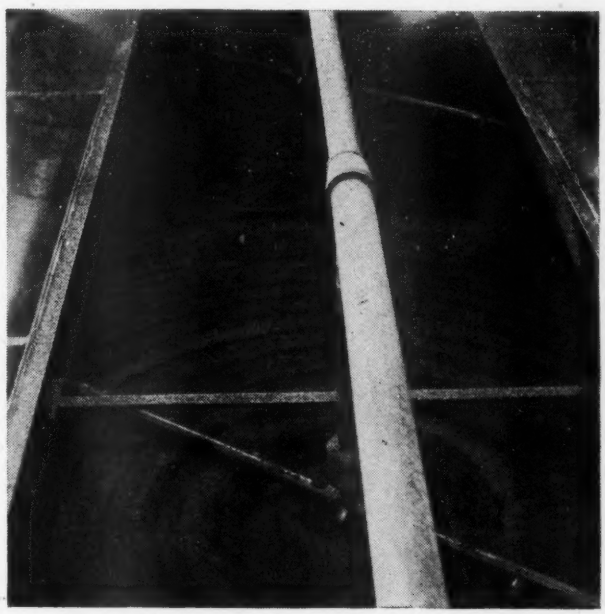
State Dept. of Health and, in accordance with his recommendations, increased the wash periods from the usual 5 minutes up to 20 minutes. Checking up on the operation, we found the expansion of the filter varied from a maximum of 4″ to 2½″ in some filters; vertical rise was 24″. Samples of sand were checked and found to have effective size of 0.45 mm and uniformity coefficient of 1.54.

To remedy the clogging, we tried flake caustic soda, draining down the filter and spreading 2½ lb. per sq. ft. of filter area over the dry sand, then filling the filter with filtered water up to the top of the troughs, then draining this to waste down to a point about 2″ above the sand. After standing for 48 hrs. the filters were washed, washing for 80 to 90 minutes being necessary before the wash water ran clear.

Wishing to learn the actual condition of the filters, in December we constructed a wooden box 4 ft. square, without top or bottom and the full depth of the filter sand, and, with No. 4 filter expanded, sank the box between the troughs down to the gravel, and removed the sand inside of it. We found the gravel was greatly displaced and intermixed with the sand, there being only 8″ of sand supported by 34″ of gravel in one spot, while in another 32″ of sand overlay 10″ of gravel. This firmly convinced us that radical changes were necessary.

Plant Improvements

After corresponding with various sand and gravel companies and with Prof. H. G. Turner of the Anthracite Equipment Corp. we decided to adopt a complete anthrafilt installation for the following reasons: 1—The limited capacity of the drains and wash troughs prevented our adopting a high-rate wash, which would not be necessary with anthrafilt; and as the gravel could not be used again without being cleaned (which we had no facilities for doing), we used coarse sizes of anthrafilt for this also. 2—The cost of this use of anthrafilt would be less than of sand and gravel delivered at the plant. 3—The claimed higher rate of filtration due to our being able to use a larger effective size than was possible with sand and still get the desired expansion with our limited vertical rise. (An increase in capacity by 1/3 seemed desirable since, during summer months in the past, it had been necessary to operate the plant at or near maximum capacity. This was obtained by use of anthrafilt in the existing filters but would have required building new filters if sand were used.)

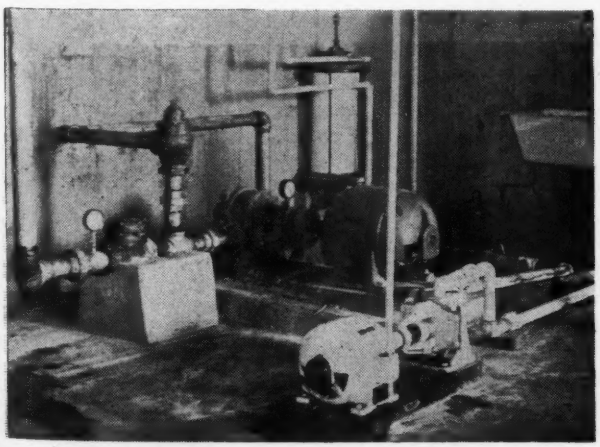


Filter agitator; angle irons bolted to wash troughs.

Prof. Turner advised us as to the sizes of anthrafilt and depth of each which would be best for our purpose. At the same time he recommended the installing of Palmer filter agitators, and we learned of so many completely satisfying installations of this equipment that we decided to include it in our plans.

By March of 1944 details of the proposed changes had been assembled and the cost estimated at $6,000, and Mayor Spear and the Common Council granted our requested permission to proceed with the installation.

Labor for removing the old sand and gravel and placing the anthrafilt was furnished by the Dept. of Public Works, of which the water works is a part, and work began on March 28 and was completed in all six



Burks pump in foreground; Westco in background, with check and relief valves on discharge.

filters on April 12. A plank platform was placed across the wash-water troughs and from two to four men shoveled the sand and gravel out of the filter up onto this platform; two men on the platform shoveled it into rubber tired wheelbarrows on the operating floor, and two men wheeled it to a concrete chute coupled to a borrowed coal chute, which conveyed the material down an elevator shaft to a dump truck outside the plant. The anthrafilt was ordered shipped in bags, and the convenience and ease of handling more than offset the extra bagging cost. Shipment was made in three carloads, each car having enough of the four sizes to complete two filters. This material was piled outside the filter room window and handed into the plant through the window.

After removing the sand and gravel it was evident that there had been an insufficient depth of gravel over the nozzles in the manifold main, as these were about 9½" above the filter floor. To remedy this we removed these nozzles and plugged the holes; then drilled and tapped holes in the manifold laterals to receive these 80 nozzles, locating them alternately as near as possible to the main and to the wall end, respectively. This gives us 5" of No. 5 anthrafilt (9/16-13/16 in.) over them, the depth of this size being 11". Above this is 3" of 5/16-9/16 in. and 3" of 3/16-5/16 in., supporting 24" of No. 1, which has an effective size of 0.60-0.70 mm and uniformity coefficient of not over 1.60.

When the 11" layer of No. 5 had been placed we backwashed the filter with the vertical rise of 24", without the least sign of disturbance; and the same was repeated after placing each succeeding layer, with no sign of movement. This led us to believe that so long as the laterals do not become corroded or plugged and the No. 1 anthrafilt remains clean and free of mud balls, we will not experience any more upset gravel.

The Filter Bed Agitators

Due to delay in obtaining fittings and the pump for installing the filter bed agitators, this part of the installation was not completed until Sept. 15. Each filter has two 9'9" agitator arms revolving on a bronze bearing at 12 to 24 rpm under 75 lb. nozzle pressure. The filtered water which operates these is furnished by a Westco turbine pump powered by a 20 hp GE high starting torque motor, which provides the two agitator arms with 120 gpm against a total dynamic head of 210 ft. at the nozzle, giving 0.5 gpm per sq. ft. of filter area. The pump takes its supply from the 20" filter effluent line, there being no clear well. The turbine type pump was chosen so it could also be used as a stand-by to supply a 2,500 gal. pressure tank which furnishes treated water to the chlorine machines, dry feed machines, hydraulic main line valve, boiler, etc. We also piped from this Westco in such a manner that we can use it for washing the distribution reservoirs and coagulation basins. The pump can be changed from one of these services to the other by means of a double-throw switch.

Method of Washing

Using this installation, we wash our filters as follows: The filter is drained down so that water just covers the agitator arms and then the Westco pump is started. After allowing the agitator arms to operate for about one minute, during which time the top mat of foreign material is broken up, the regular wash-water pump is started up and run at an 18" vertical rise or 2,700 gpm, for ten minutes. The Palmer wash is stopped about a minute ahead of regular wash, which allows the vertical rise to level off the filter medium.

At present, with the water temperature at 36° F., we are obtaining 4½" expansion, about 19%, which appears to be sufficient in our case to do a very thorough cleaning job. This percentage of expansion would be extremely insufficient were it not for the assistance of the agitators.

Prof. Turner, during a personal inspection of our installation the latter part of May 1944 noted our rather poor floc and suggested trying activated alum. A sample was obtained and used in extensive jar tests and the results were so promising that we ordered a car load of it and began using it the latter part of August. During September and October, when treating an average of 3.353 mgd, we used an average of 67.9 lb. of activated alum per mg and no lime, and obtained greatly improved coagulation. There was no drastic change in the raw water during this period, as is shown by the accompanying figures:

Month	*Temp. F.*	*Turbidity, PPM*	*Color, PPM*	*pH*	*Alkalinity to MO, PPM*
Aug.	69.5	Raw 14 —Fin. Trace	Raw 14.5—Fin. 0	Raw 7.6—Fin. 7.3	Raw 93.0—Fin. 83.0
Sept.	60.5	Raw 11.1—Fin. Trace	Raw 12.0—Fin. 0	Raw 7.6—Fin. 7.4	Raw 98.0—Fin. 93.0
Oct.	53.0	Raw 14.2—Fin. Trace	Raw 21.8—Fin. 2	Raw 7.6—Fin. 7.4	Raw 104.0—Fin. 98.0

The operation of the filters, using anthrafilt and the filter bed agitators during the past ten months, compared with the same months of the preceding year are shown by the accompanying figures. These do not fully show the great improvement, because of the incompleteness of the installation during the latter period. Although 23.5% more water was treated, the average filter runs were 96% longer and the amount of wash-water used was 48% less, or 41% less per mg.

FILTER OPERATING DATA, BEFORE AND AFTER SUBSTITUTING ANTHRAFILT

Dates	*Water Treated, 1000 Gals.*	*Wash Water Used, 1000 Gals.*	*Filters Washed*	*Aver. Run, Hrs.*	*Min. Run, Hrs.*	*Max. Run, Hrs.*	*% of Wash Water*
April 1943 to Feb. 1944.....	781,435	48,396	1171	30.2	9	96	6.3
April 1944 to Feb. 1945	965,180	25,074	778	59.4	19	192	2.6
	+183,745	—23,322	—393	+29.2	+10	+96	—3.7

In 1939, on two separate days, they had managed to filter 4.6 mgd by washing every eight hours and operating with the rate controls wide open. Last summer, before either the filter bed agitator or the activated alum had been put into use, we ran for five consecutive days at an average rate of 4.7 mgd, reaching 4.85 one day, without crowding and with the rate controls operating, and washing after slightly over 24 hr. run, with an average loss of head of not over 4 ft. The effluent was very fine at the end of the runs, no sign of color or turbidity, although during this period we were getting poor coagulation. This output would have been impossible with our old sand filters and would have caused grave concern without capacity to meet this unusual demand. We can now, without effort, filter through our anthrafilt at the rate of 6.2 mgd.

Cost of Improvement

The cost of this project is herewith given:

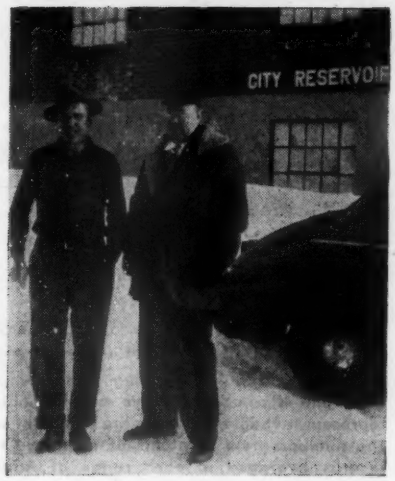
Anthrafilt, approximately 125.5 tons	$1662.90	
Freight on same	411.91	$2074.81
12 Palmer filter bed agitators.....	1604.40	
Freight on same	8.49	1612.89
Westco Pump, 20 h.p., G.E. Motor, magnetic starter	476.60	
Freight on same	17.66	494.26
Piping, valves, fittings, misc. supplies.....	701.16	
Freight on valves	2.70	703.86
Electrical supplies and equipment.....	55.50	55.50
Labor, for removal of sand and gravel and the handling of Anthrafilt from freight house to plant—1226.4 man-hours at $.55	674.50	674.50
Trucks for hauling away sand and gravel and hauling Anthrafilt from freight house to plant (Dept. of Public Works Trucks)	186.00	186.00
Air compressor and portable pump (Dept. of Public Works Equipment)	50.00	50.00
ACTUAL TOTAL COST.....		$5851.82

Labor for the installation of the pump and motor, wiring, etc., and the installing of the agitators with the necessary piping, was not included in the cost figures as this work was done by the plant attendant and myself. Under these conditions we accomplished the installation $148.18 under our estimate of $6,000.

During the first 10 months of incomplete installation, from April 1944 to February 1945, we have saved $742.50 in operating costs over the corresponding months of a year ago. Included in this figure is the item of 23,322,000 gallons of wash-water saved which represents $543, resulting from our washing 393 less filters, together with the fact that we can, with anthrafilt and Palmer agitators, wash a filter effectively with 27,000 gallons of water as compared to 36,000 formerly used. Also, we now have filter runs ranging from 120 to 192 hours, as compared with sand filter runs of from 24 to 48 hours. During this same period, as compared with a year ago, we saved 2,000 lb. of chemical hydrated lime, at a cost of $12.50, plus the use of over 7 tons less alum since September, at a cost of $196. Based on these incomplete figures, the annual savings can reasonably be expected to approximate $1,000. In other words, we shall write off this $6,000 investment in about six years and at the same time enjoy the benefits of our toils together with properly operating filters.

It has been a very trying undertaking for me, particularly because I lacked experience in this sort of thing. I don't believe that it is customary for an operator, especially in a small plant, to undertake such a task without professional advice; but I accumulated a file about 8" thick of correspondence and literature on filter problems, made rough sketches of the proposed pump location and piping layout and from these figured estimates of material, equipment, etc., as best we knew how. We borrowed freely of equipment and tools from several sources.

We wish to express our thanks to Mayor M. Spear and members of the Common Council for having enough confidence in our judgment to grant approval and funds to complete this project; to Thomas G. Burke, Supt. of Public Works, who is in direct charge of the Water Department, for his invaluable assistance and wholehearted cooperation in furnishing labor and equipment and general supervision; to Walter Gottburg, Supt. of Municipal Light Dept., for detail plans for wiring arrangement, tools and suggestions on pump installation; to Clifford Fleming, Chief of Police, as official photographer during project and for his suggestions of flushing with portable pump to remove sand and gravel lodged under and between the laterals; to James A. Stalbird, District Sanitary Engineer, State Dept. of Health, who was with us right from the beginning of our troubles and without whose help and advice the whole project might have fallen by the way; to William Garrant, filter plant attendant (now in the armed forces) for the manual labor, overtime work and general interest in the whole plan; to Plattsburgh Stone Products Corp., for use of their screens and shaking apparatus; to Lee Heath, engineer, Sager-Spuck Supply Co., Inc., Albany, N. Y., for consultation in connection with proper type and size pumping equipment and valves, etc.; to various trade publications for published articles and suggestions, together with considerable correspondence, namely, PUBLIC WORKS, Water Works Engineering, Water Works & Sewerage; to Stuart-Brumley Corp., for assistance given concerning Palmer filter bed agitators and activated alum; to C. E. Palmer, president, Palmer Filter Engineering Co., for plans and numerous helpful suggestions not only with the installation of his agitators, but information in general in connection with filter problems; last (but only because I have chosen it to be this way) to Prof. Homer G. Turner, research engineer, representing Anthracite Equipment Corp., for it was he who suggested the Palmer agitators and activated alum, plus his suggestions for the installation of the anthrafilt itself. The whole plan has worked out so successfully that we feel most grateful because, although we had decided on anthrafilt, we, at first, hadn't given the agitators much consideration.



J. A. Stalbird, District Sanitary Engineer, and the writer.

Water & Light Dept. of Fergus Falls Pays a Dividend

The Water and Light Commission of Fergus Falls, Minn., has declared a 20% dividend, to be paid to all consumers, we are informed by Dow I. Sears, superintendent of the department. Payments will be based upon the total charges made for electricity consumed during the previous twelve months. For several years past it has been customary for the department to pay a 10% dividend.

The charges for electric service are: Combination residential rate, 3.0¢ per kwh for the first 50 per month, 2.5¢ for the next 50, 2.0¢ for the next 100, and 1.5¢ for all over 200 kwh. Water heating from midnight to 7 a.m., 1¢ per kwh. Commercial lighting, 3.0¢ per kwh.

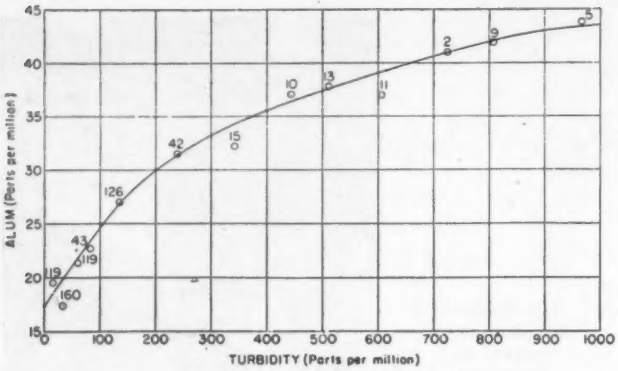


Figure 1—Relation of turbidity to consumption of alum for water filtration. A composite curve of 674 individual records from 12 representative filter plants in the Piedmont section of North Carolina. The numbers next to points of the curve represent the number of records averaged in each range of turbidity. (After Garin and Forster.)

Protecting Municipa/at

By CARL B. BROWN
Head, Sedimentation Section, Soil Conservation Service, U. S. Dept. of Agriculture

IN 1940, 560 cities, towns and institutions in 9 Southeastern States supplied some 6,700,000 persons and thousands of industries with approximately 150 billion gallons of water obtained from surface sources—streams, lakes and reservoirs.[1] In these 9 states—Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Virginia—almost all surface water supplies must be filtered to eliminate turbidity, which is caused by suspension of fine sediment and colloids. The amount and fluctuation of sediment load is controlled primarily by the rate of accelerated soil erosion on watershed lands above the source of supply. Erosion directly increases the cost of surface water to the consumer in two ways: (1) by causing excessive turbidities, which increase the cost of water treatment; and (2) by causing rapid silting, and consequent loss of capacity, of impounding reservoirs.

[1] Data obtained from "A Summary of Census Data on Water Treatment Plants in the United States" by S. R. Weibel. U. S. Public Health Service Reprint 2416, Nov. 6, 1942.

Effect of Erosion on Water Treatment Costs

The cost of treating surface water varies widely from stream to stream, from season to season, and with plant design and efficiency. In general, however, the greater the sediment concentration in the raw water (above 50 to 100 ppm.), the higher are the

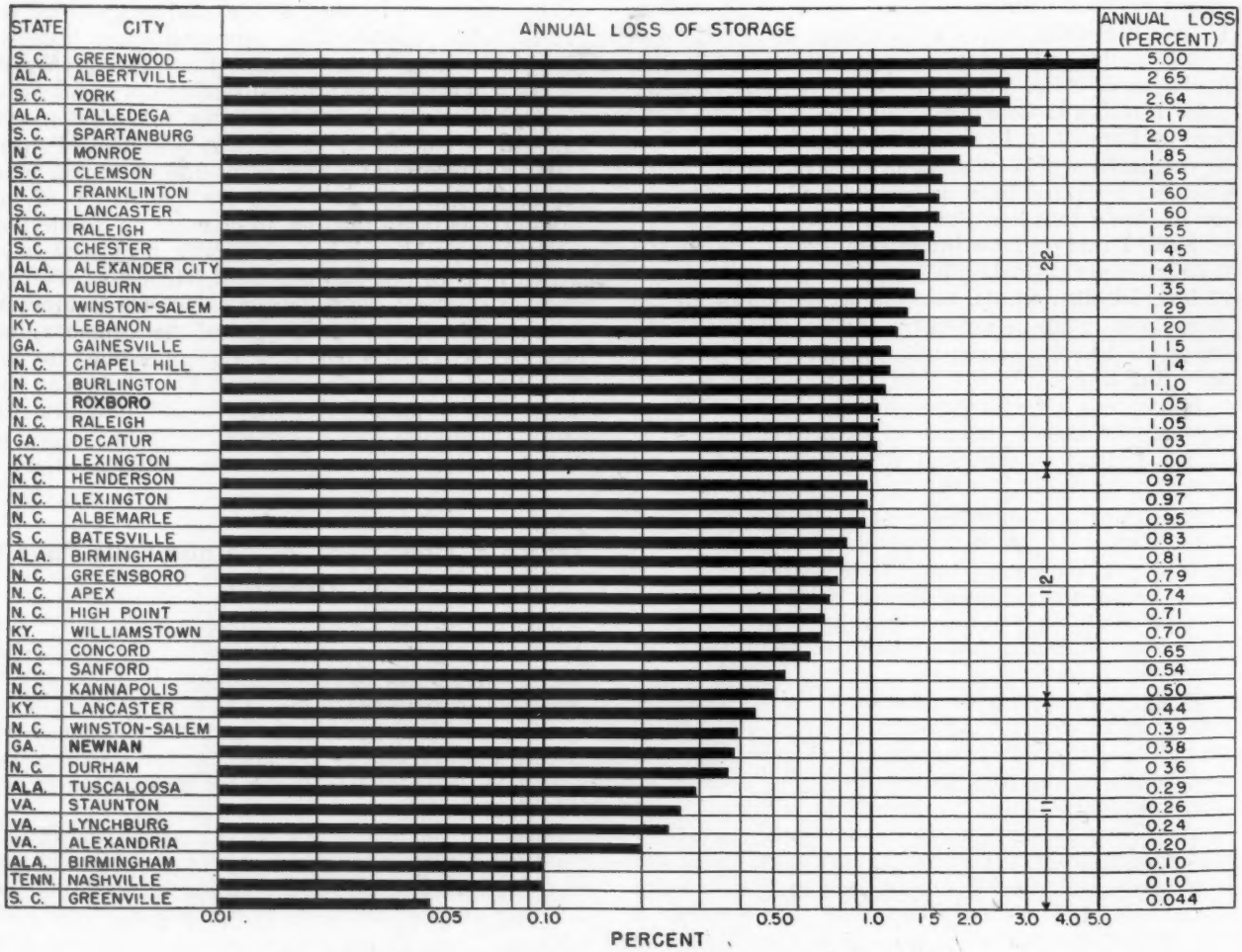


Fig. 2—Rates of silting of water supply reservoirs in Southeastern United States.

ipa/atersheds in Southeastern States

Elimination of erosion would reduce cost of water treatment and silting up of reservoirs. Cities can aid in this by cooperating with the Soil Conservation Service in inducing and aiding farmers to control erosion on their lands.

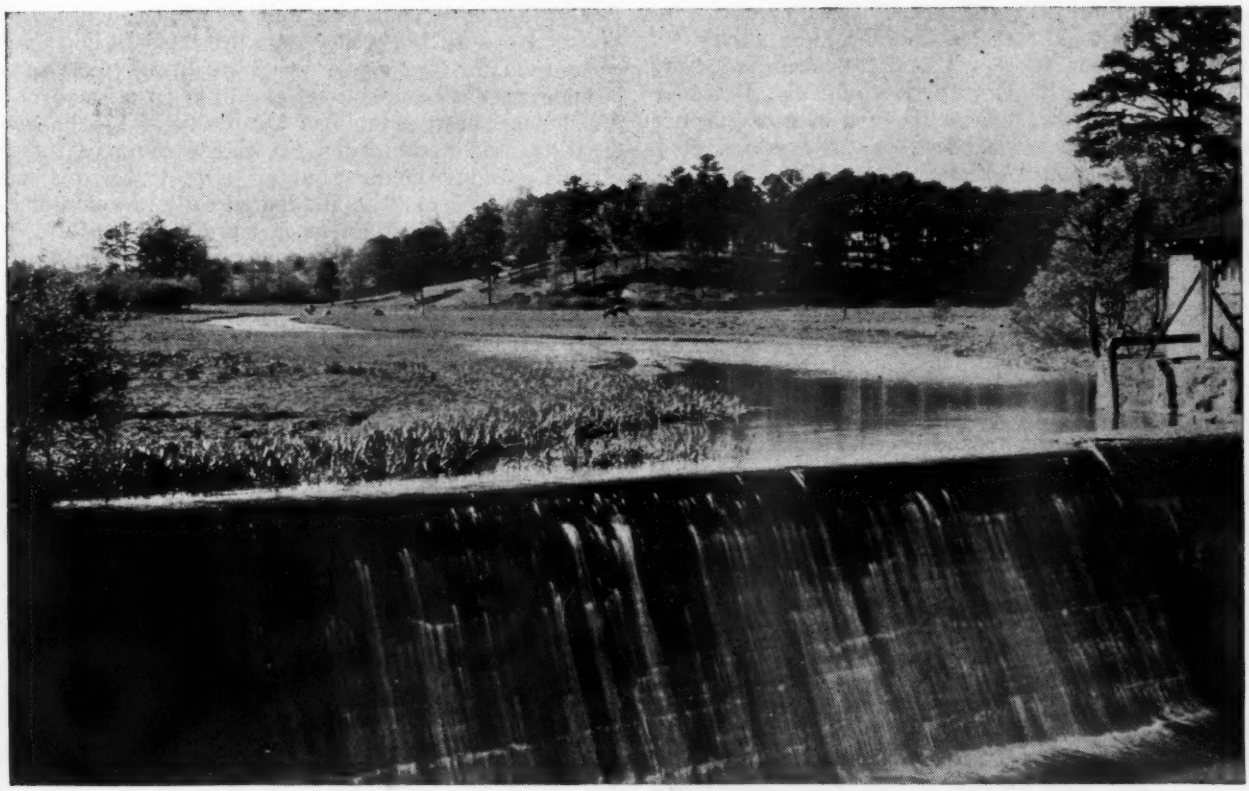


Fig. 3—Completely silted small reservoir at Mayfair Mills, Arcadia, S. C. Constructed since 1920.

treatment costs and the capital outlay for treatment plants.

Several years ago, research economists[2] of the Soil Conservation Service, cooperating with the North Carolina Agricultural Experiment Station, made an analysis of the costs of water treatment by 22 cities in the Piedmont area of North Carolina. In 1937 these cities treated approximately 13.5 billion gallons of raw water. Their cost for chemicals was $68,000 or about $5.00 per million gallons, the larger part of which was for alum used to flocculate the fine colloidal sediment. Figure 1 shows the average relation between the use of alum and the turbidity of the raw water. This study indicated that if the suspended matter in the raw water could be reduced 25% to 30%, on an average, a saving in chemical costs of $1.50 per million gallons of water treated would result. This degree of reduction would be a very modest expectation from an adequate soil conservation program on Southern watersheds.

Existing data indicate that in this region about 90% of the fine suspended matter comes directly from erosion on sloping lands, mainly as a result of continued use of improper farming methods.

In the opinion of numerous water-supply engineers and plant superintendents interviewed during this study, substantial savings would also result over a long-term period from smaller capital outlay for settling basins and filter plant units, and lower power, labor and other costs for back-washing the filters and for flushing or cleaning the settling basins. Considering the various probable savings from a decrease of 25% to 30% in the suspended load of the streams, it was estimated that the overall cost of treatment would be reduced about $7.00 per million gallons, or that the cost of finished water at the filter plant would be

[2] See Garin, A. N., and Forster, G. W. Effect of soil erosion on the costs of public water supply in the North Carolina Piedmont. U. S. Soil Conserv. Serv. SCS-EC-1. 106 pp., illus., processed. Washington, D. C., July 1940.

reduced from an average of $70 to $63 per million gallons.

The watersheds from which these 22 North Carolina cities obtain their water supply have a total area of approximately 500,400 acres, on which the land was valued (1937) at $10,900,000 and the buildings at $6,000,000, or a total of $16,900,000. The cost of the water supply facilities, not including the distribution systems, in the same watershed was $8,000,000, or nearly 50% of the capital value of all the farm lands and buildings. Furthermore, the cost of the treated water supplied from these watersheds is $925,000 annually, which is probably not much, if any, less than the average net returns from agriculture on these watersheds.

Effect of Erosion on Impounding Reservoirs

One or more impounding water-supply reservoirs have been built by each of 189 towns, cities and institutions in the 9 Southeastern states at a cost of approximately $23,500,000. Sedimentation surveys of 45 of these reservoirs show that half of them are losing more than 1% of their capacity annually. Based on the assumption that they will cease to give effective service before they have lost, on an average, 60% of their capacity, it is estimated that 33% of them will have a life of less than 50 years, and 56% a life of less than 75 years. As the average age of these reservoirs is now 20 years or more it is apparent that a widespread replacement program will be necessary during the next several decades unless silting rates are drastically reduced by erosion control on their watersheds. Several cities, including Raleigh, Winston-Salem and Birmingham, have already been forced to build new reservoirs as a result of a combination of increased water demand and decreased reservoir storage capacity. A number of smaller reservoirs have been completely silted and abandoned. Approximately 2,065,000 persons and hundreds of industries in these Southern communities will have to pay higher taxes or higher water rates to cover the reservoir replacement costs resulting from lack of erosion control on their watersheds.

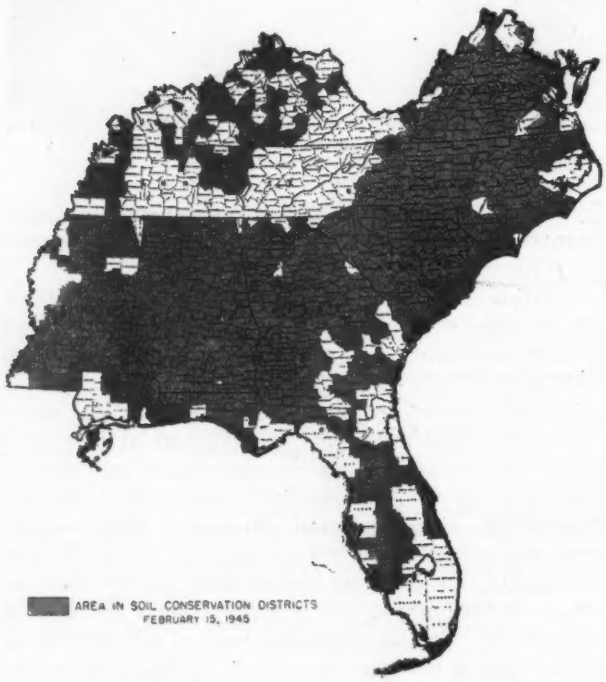


Fig. 4—Area of southeastern states in Soil Conservation Districts on Feb. 15, 1945.

Securing Watershed Protection

It has been generally conceded for 50 years that forests have a stabilizing effect on stream flow and tend to prevent erosion, high turbidities and silting. Many cities and water companies, especially in New England and the Middle Atlantic States, have embarked on programs of watershed purchase and reforestation.[3] The value of this work has been almost universally acclaimed by the watershed owners—the people themselves. Unfortunately, such a program has only rarely been adopted in the Southern States, where erosion and silting conditions are far more critical and turbidities are much higher than in the North. There are probably a variety of reasons for this, not the least of which is the fact that ordinarily a higher proportion of watershed lands are in cultivation and hence more costly.

Experienc at Newnan, Georgia. Newnan, Georgia, has given an outstanding demonstration in the South of the value of purchase and reforestation of small watersheds. In 1924, Newnan constructed an impounding reservoir and a new water treatment plant on a small creek 1½ miles southeast of town, at a cost of $75,000. The reservoir had a capacity of 125,000,000 gallons and a drainage area of 890 acres of rather badly eroding land. A major part of the area has slopes of 12% to 20%, and had already lost more than half of its topsoil. Not much more than one-third of the area was covered by second-growth scrubby woodland. City officials familiar with the early history of the reservoir report that summer rainstorms would produce flash runoff, raising the water level several feet and causing spillway overflow, but within a few hours the water level was again receding. Sudden high turbidity in the raw water caused the usual filter plant difficulties.

The city began purchasing watershed land and embarked on a reforestation program in 1925, and to date 800 acres, or all but one farm, have been acquired at a cost of $32,000. Land was taken out of cultivation as soon as purchased. More than 100,000 slash and other varieties of pine have been planted to supplement natural reseeding, and eight miles of firebreaks have been cleared. A large number of wire and brush check dams have been constructed across old gullies and washes. At present 83% of the watershed is in forest or new plantings, only 10% is still open land, and 7% is urban area in the fringes of the city. A full-time city employee maintains constant sanitary and fire inspection of the watershed and supervises plantings. Excluding land purchase, the improvement and maintenance program has cost the city $2,500 to $5,000 per year.

What have been the results of this program? A study of sedimentation in the Newnan reservoir by the Soil Conservation Service in November 1937 indicated an average loss in storage capacity of 632,000 gallons per year during the previous 13.4 years. This is equivalent to about one day's water supply per year. In February 1945 the writer made another sedimentation survey which showed that the average capacity loss during the 7.3 years since the previous survey has been only 179,000 gallons. In other words, the average rate of storage loss has been reduced 62%. Careful examination of the watershed leaves little doubt that when the single remaining, badly eroding orchard can be purchased and planted, silting in the reservoir will be reduced to negligible proportions.

[3] See "The Control of Reservoir Silting" by Carl B. Brown. U. S. Dept. Agri. Misc. Pub. 521, 166 pp., illus. Washington, U. S. Govt. print. off., 1944.

The daily raw water turbidity records for 1942 through 1944 show a maximum of 200 ppm in March 1942. In only 8 months out of 36 did the turbidity at any time go above 100 ppm. Unfortunately, records prior to 1935 are missing, and are incomplete to 1940. However, turbidity of 350 ppm was recorded July 17, 1940. Figure 1 shows that turbidities of 500 to 1,000 ppm in raw water from impounding reservoirs in the Southern Piedmont are not uncommon. Turbidities this high or higher were doubtless common in the Newnan reservoir, for sediment production from this watershed during the earlier years was about three times the average for the Southern Piedmont.

In addition to reduction of turbidity and silting, there appears to be a marked stabilization of stream flow. Some 27 springs have been developed in the watershed, and city officials say most of these did not exist prior to the planting program. Intense rainstorms no longer produce the flash floods that are reported to have been common in earlier years. Often the reservoir is still rising 24 hours after rain ceases. There is less spillway loss, and this is important now because Newnan's average daily water consumption has risen from 648,000 gallons in 1942 to 707,000 gallons in 1943 and 768,000 gallons in 1944. Much further reduction in the reservoir capacity would make the water supply precarious.

Experience at Roxboro, N. C.—But what can be done by cities whose watersheds cover many thousands or even hundreds of thousands of acres, where land values of $50 to $100 per acre or more make purchase of entire watersheds impracticable? Fortunately, since 1936, a new avenue to better watershed protection has been opening up through the locally-organized and supervised Soil Conservation Districts. Every state in the South has enacted a Soil Conservation District law, and those sections of most states where erosion is a problem have already been organized into Districts. The Districts are governmental subdivisions of the State, controlled by landowners and farm operators and supervised by a locally-elected Board of Supervisors. The Soil Conservation Service and other agencies of the Federal and State Governments co-operate with these Districts by supplying technical assistance in farm and watershed planning for soil conservation, water conservation and drainage, and related improvements in agriculture.

In April 1924, Roxboro, N. C., completed a municipal reservoir which had a capacity of 197,726,000 gallons. In June 1941 a sedimentation survey showed that the reservoir had lost 18% of its capacity, at a rate equivalent to 2,000,000 gallons of storage space, or more than 2 days' water supply, per year. As a result of this disclosure, the city requested the supervisors of the Dan River Soil Conservation District and Regional conservation specialists of the Soil Conservation Service to recommend a plan for protecting the 4877-acre municipal watershed against the rapid erosion then current. All of the watershed land is in private ownership.

The detailed watershed survey made by the Soil Conservation Service showed that cropland covered 2,046 acres, of which 367 acres was land unsuited to cultivation that should be converted to permanent pasture or woodland. However, out of 2,484 acres of woods and pasture, 947 acres was suitable to be used for cropland, if needed, with proper soil conservation practices such as rotations, terracing, strip cropping, etc. The survey delineated the critical sediment-producing areas on farm land and also showed the erosion-control treatments needed on roads crossing the area.

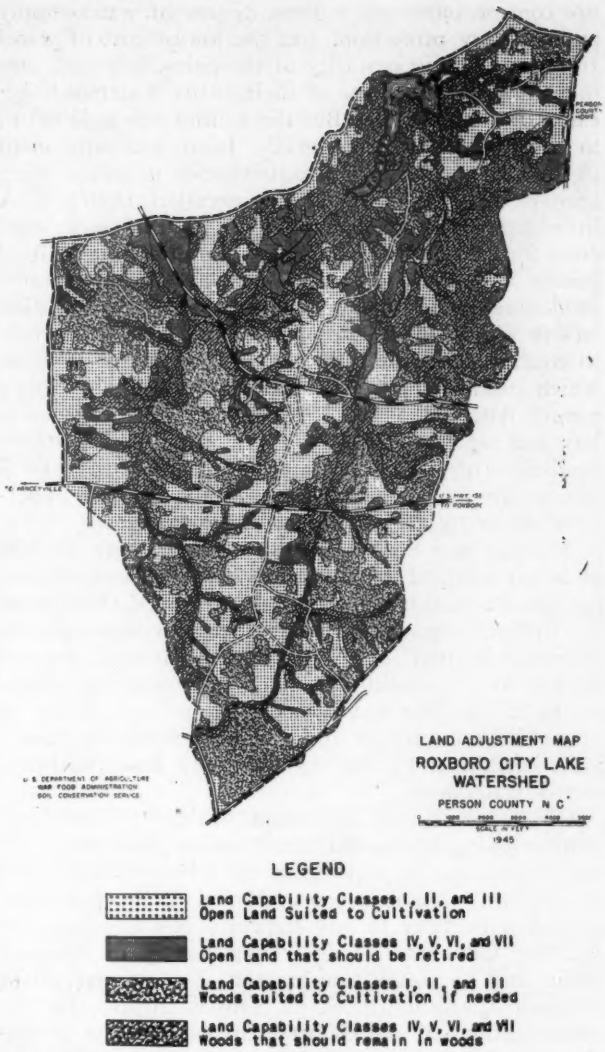

LAND ADJUSTMENT MAP
ROXBORO CITY LAKE
WATERSHED
PERSON COUNTY N C
1945
LEGEND
Land Capability Classes I, II, and III
Open Land Suited to Cultivation
Land Capability Classes IV, V, VI, and VII
Open Land that should be retired
Land Capability Classes I, II, and III
Woods suited to Cultivation if needed
Land Capability Classes IV, V, VI, and VII
Woods that should remain in woods

Fig. 5—Land adjustment map, Roxboro, N. C. City Lake watershed.

Following up the survey, agreements have been signed between the District Supervisors and 22 of the 50 landowners in the watershed to follow conservation plans developed co-operatively by the farmers and conservation farm planners of the Soil Conservation Service. It is expected that when the current shortage of technical personnel is relieved, plans can be developed with most of the remaining owners, many of whom are absentee landlords who can be reached only with some difficulty.

The City Council of Roxboro authorized the expenditure of $1,000 to assist in the watershed program. To date about $300 of this amount has been spent for seed, which was contributed to the landowners for use in establishing permanent vegetated waterways in the draws and field drains. Such waterways form filter strips in which the water loses most of the sediment washed from adjacent fields. Experience has shown that they are one of the most effective methods of preventing fine sediment from reaching the main streams.

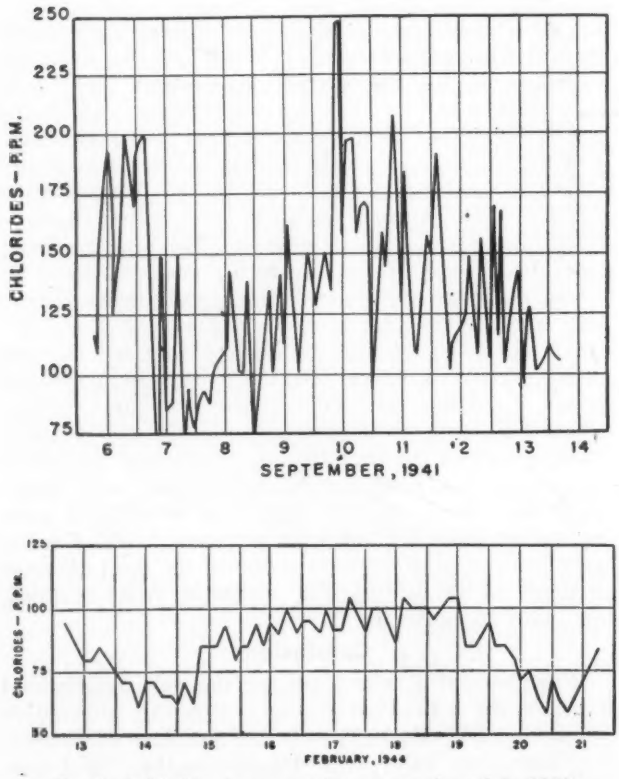
Conclusions

Newnan and Roxboro are not the only foresighted cities in the South, but they well illustrate alternative solutions—both desirable—to the problem of protecting municipal watersheds. Unquestionably, land purchase and reforestation, with proper management and

fire control, offers the highest degree of water-supply and sanitary protection, and the lowest cost of water treatment. A big majority of the cities, however, cannot afford the purchase of their entire watersheds because of size and cost. But these cities *can* well afford to contribute funds, materials, labor and equipment to the erosion-control and conservation program being carried through the Soil Conservation Districts. A little aid, strategically placed—a gift of seed, concrete for a check dam, loan of a bulldozer—will often enable a farmer to control erosion on critical silt-producing areas and to complete a conservation plan on his whole farm. The city can aid very effectively in control of major gullies and stream-bank erosion, which often requires resources beyond the farmer's means. Also, many cities may find it advantageous to buy and reforest certain severely eroding areas where conditions of land ownership or other factors make it impossible for the Soil Conservation District Supervisors to negotiate a conservation agreement.

Scarcely any form of public works is more flexible, or better adapted to use temporarily idle construction equipment, road machinery or labor forces. Once plans are drawn, no public works can better stabilize month-to-month fluctuations in employment demand for unskilled and semi-skilled labor. Certainly no public works in the post-war period will be more likely to attract new industries and desirable residents than a safe, certain and clean water supply from well-protected watersheds.

Cities, towns and institutions which are interested in developing watershed conservation plans can start the ball rolling by consulting the District Supervisors or the local District Conservationist of the Soil Conservation Service. If any difficulty is experienced in locating these officials, their names may be obtained from the Regional Conservator, Soil Conservation Service, Spartanburg, S. C. Similar information for other sections of the country can be obtained by addressing the author at his Washington, D. C. address.



Trend of chlorides in sewage for a normal week in 1944.

Locating Infiltration of Salt Water Into Sewer

When the Bethlehem Steel Company was studying the possibility of using, in connection with manufacturing processes in its Sparrows Point plant, effluent from the Back River sewage treatment plant of Baltimore, Md., it found that a serious objection was the high chloride content, which ran as high as 6,000 ppm under certain conditions of river level, industrial discharge and rainfall. The domestic sewage had a practically constant chloride concentration of 40 ppm, but high chloride content was found in the sewers around the harbor section, which are 3 to 10 ft. below mean tide water. It was found that the chloride content varied directly with the tide level, except for very high peaks of short duration probably due to industrial wastes. It seemed to be demonstrated, therefore, that most of the chloride was from infiltration of harbor water which averaged 3,000 ppm of chloride ion concentration, indicating as high as 19% infiltration water in the sewage. By sampling the sewage at various manholes along the interceptors it was possible to locate approximately many of the points of infiltration into the sewers, and also to trace contamination directly to industrial plants such as soap manufacturing, meat packing and pickling, zeolite water softening, etc.

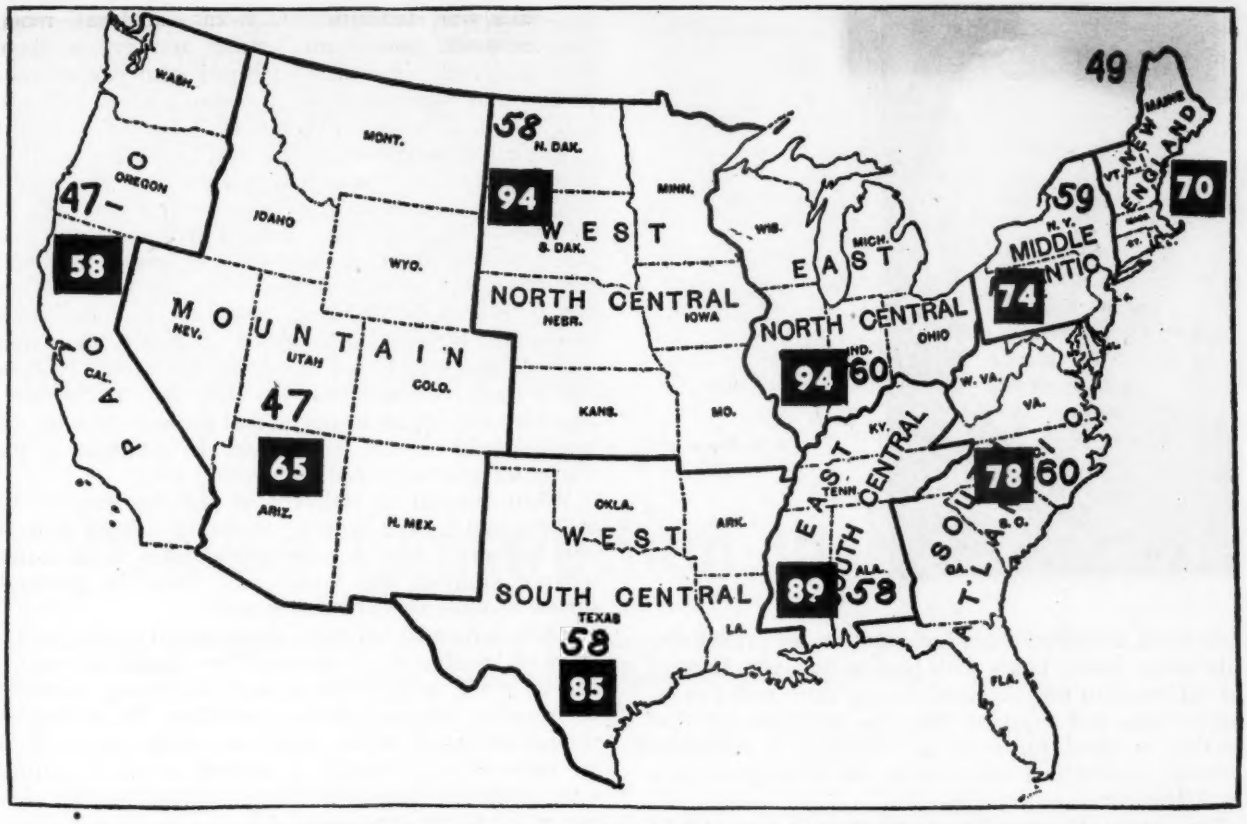
The distances between manholes where the lower showed an increase in the chloride content over the one above were often 300 to 400 ft. In order to explore the pipe lines between manholes, a small electrode was fastened on wooden blocks and floated through the sewer. To the electrode was fastened 500 ft. of two-strand rubber-covered cable, to the other end of which was attached an alternating current Wheatstone bridge. By taking conductivity readings of the sewage every few feet along the sewer, the exact location of increase in chloride contamination was found, since conductivity of the sewage increased as the chloride content increased.

With the information so obtained, most of the leaks were repaired and chloride contamination almost completely eliminated. Whereas formerly the chlorides varied from 75 to 600 ppm in 1941, in 1944 they averaged about 80 and seldom rose above 100.

The above is abstracted from a paper by William P. Hill, steam engineer at the Sparrows Point plant, before the Maryland-Delaware Water and Sewerage Ass'n.

Liability for Excavation Accident

A board over a trench, part of the construction work of a road, broke while a girl was crossing it from the road to a residence. In an action for injuries sustained by the girl against the contractor in charge of constructing the road and the trench, there was no evidence that the contractor was not duly authorized by government authority to dig the trench, or that the road was open for travel, or that the existence of the trench was not obvious so that a sign or barrier was required, or that the contractor was under any duty to the plaintiff to provide access to the house over the trench, or that there was any duty on defendant to remove the board or to guard against injury to persons using it to cross the trench. It was held that the evidence authorized a directed verdict for the contractor. Berri v. B. Perini & Sons, Inc., Massachusetts Supreme Court, 13 N. E. 2nd, 406.



Metered services in the United States. The lower figures represent the number of cities in each district that report their services 100% metered; the higher figures, the number more than 90% metered.

Meter Maintenance for Small Waterworks Departments

How, in a city of 7,000 population, a metering program, including a meter repair shop competently run, produced a net increase in revenue of over $6,000 a year.

By C. H. SHORE
Superintendent of Utilities, Coleman, Texas

ON April 1, 1942, Coleman, Texas, a city with 7,000 population which owns its own water works, having completed a survey of its water meters, began the execution of a planned meter maintenance program, including the operation of a meter repair shop, which is yielding us a net annual increase in revenue of over $6,000.

In July, 1940, I became Superintendent of Utilities of Coleman and shortly thereafter made a limited investigation which showed that the city was losing considerable money because of the ineffectiveness of its metering system. I was convinced that the only remedy was to make a complete survey of our water meters, install a meter repair shop and adopt a meter maintenance program. Nothing definite was done until December, 1942, when we began to collect and compile actual facts that would either prove or disprove the desirability of a meter maintenance program and a meter repair shop.

This survey gave us the following information, which was used as a basis for our maintenance program:

Total number of water accounts	1,761
Unmetered accounts	201
Meters in service	1,560
Meters found on abandoned accounts	126
Meters set outside meter boxes	134
Meters set in meter boxes	1,426
Meters in boxes with lids and locks	324
Meters in boxes without lids and locks	1,102
Readable meters	1,238
Unreadable meters	322
Average number of meters replaced monthly because of non-registration	11
Compound meter in service	1

There were no facilities for repairing meters. None of the meters was shop numbered.

Most of these data were obtained by the meter readers and entered on memo sheets under such items as

C. H. Shore

unmetered accounts, unreadable meters, meters set outside meter boxes, boxes with broken lids, etc. Most of the information was obtained during three meter reading periods, and required little time additional to that usually required for reading. Securing it otherwise probably would have required the services of two men for fifteen days.

This survey thoroughly convinced us that we should install a meter shop and maintain our meters by a satisfactory system.

The first necessity was to meter every account, which would require 201 new meters—really 523, since 322 of the meters were unreadable. To put every meter in a satisfactory box would require 335 new boxes with rings and lids and 1,437 meter box lids and locks.

The finding of 125 meters on abandoned accounts (where houses had been moved, burned or permanently vacated) was lucky, for we repaired these at an average cost of less than $2.00 each and then put them in service.

During the previous 18 months we had bought an average of 15 new meters a month, only 4 on new taps and 11 to replace meters that were junked but could (we learned later) have been repaired for approximately $2.50 each.

None of the meters had been shop numbered, and all were numbered during the regular maintenance routine.

I realized that meters would pay dividends only if properly maintained by trained employees. It seemed to be impossible to hire a man experienced in repairing meters and the only solution was to have one of our men trained in testing and repairing under a good meter repair man. Knowing that Albert Davis, superintendent of the water works department of Austin, Texas, and Walter Pollen, his meter shop foreman, had made an outstanding achievement in the operation of their meter shop, we arranged with them to let Henry Ward, an employee in our department, work in their shop free of charge for the training. I did not expect that the limited experience he would get at Austin would make him an expert meter repair man, but it laid the foundation, and with the succeeding three years' experience in our shop he has become far above the average repair man, in the opinion of those who should know.

Room for the meter shop was obtained by partitioning off a space of 24 x 22 ft. in our warehouse, and this was subdivided into three rooms—acid bath room, records room, and main testing and repair shop. The acid bath room was equipped with proper containers and ventilation for cleaning meters by acid, and also a disassembly bench and sink. The record room equipment consisted of a small desk and a filing cabinet for shop records. The main testing and repair shop was equipped with a Neptune test bench of 6-meter capacity, calibrated tanks, a drill press, and two small motors equipped, one with an emery rock and the other with a fine wire-wheel brush for finishing and polishing. In this room also we placed two work benches 10 ft. by 32 in., covered with galvanized iron with all seams soldered. One bench has a sink built in and a small vise attached; the other has, at the back, bins for stocking meter parts; and drawers beneath the benches hold all the hand tools. In addition to the above, we also bought a field-testing kit.

When assured of delivery of this equipment, we ordered meter parts, aiming to obtain enough of each item to prevent delay in shop operation, once our maintenance program was under way. This our previous survey enabled us to do fairly well.

There cannot be too much stress placed on the importance of keeping shop records. They should be simplified as much as possible without sacrificing valuable information required in shop operation. The system of records which we set up coordinates shop routine with the main office sufficiently to prevent errors in billing water accounts, and provides all the information necessary for future reference.

A testing procedure was then established, of which some of the most important points were as follows:

(a) Normal test flow.

(b) Allowable variation and limits of variation of accuracy of registration between normal test flow limits.

(c) Minimum test flow and accuracy requirements.

(d) Rates of flow necessary for routine tests.

Using the data obtained by our meter survey, we planned a program of meter maintenance, calculated to conserve time and prevent confusion while securing the following results in the order given:

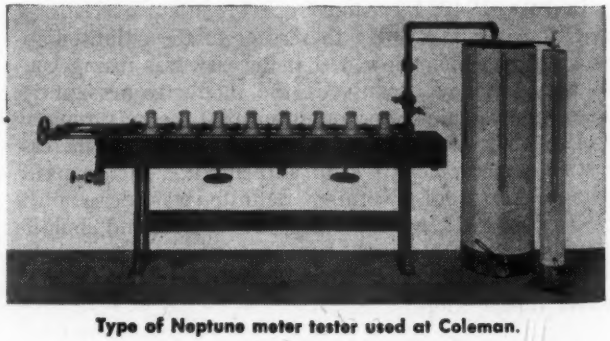
(a) Remove the 125 meters we had on abandoned or dead accounts for test and repair.

(b) Place meters on the 201 unmetered or flat accounts. These accounts were being served at a flat charge of $1.00 per month, regardless of the amount of water used.

(c) Remove for test and repair the 322 meters which were unreadable because of broken hands or broken or faded dials.

(d) Remove all the other meters in service for cleaning and testing, and for repairs if necessary (which they were in the majority of cases).

(Continued on page 54)



Type of Neptune meter tester used at Coleman.

Sewer work in Asuncion, Paraguay.

A unit of a municipal water system, Paraguay.

Sewer Construction in Paraguay

American advice and aid in building the first sewerage system in that country. Some of the handicaps encountered.

By E. N. FLETCHER

IN May of 1942 the Health and Sanitation Dept. of the Co-ordinator of Inter-American Affairs established an office in Asuncion, Paraguay, with Dr. Richard Plunkett as director. Working through and with the Paraguay Minister of Health and other government officials, they laid out a two-year health and sanitation program consisting of some twenty projects of educational and construction work. These included the building of five health centers, two in Asuncion, one in Villa Rica, one in Concepsion and one in Encarnacion; also a laundry, boiler room, water filtration plant and other work at the Hospital de Clinica; a hundred-bed tuberculosis hospital in Asuncion; and a sewer system in Asuncion. A complete sewer system was designed, and we constructed the main trunk line sewer and approximately a mile of small sewer lines to serve the larger of the two health centers and one of the market places.

Asuncion, a city of 120,000 population, is built on a hill on the bank of the Paraguay river, the harbor and business district being located along the river front. All the streets in the principal business and residential sections are paved with cobble stones. The highest point in the city is almost 300 ft. above the river and most of the streets are quite steep, and the main purpose of the pavements, laid sixty years ago, is to prevent erosion and dust. The soil is sandy, in general 2 to 6 ft. deep, overlying sandstone rock. This soil, which is highly colored with iron oxide, washes badly and unpaved streets are so full of gullies that it is almost impossible to travel over them other than in oxcarts. About 12 miles of the cobblestone pavements have been covered with two or more inches of asphalt, which gives a very satisfactory street.

E. N. Fletcher in Paraguay.

There are no basements in Paraguay so, with the exception of the outfall sewer, the pipe was laid at depths of 4 to 6 ft.—just sufficient to cushion it against traffic impacts and to go under the underground telephone and electric wires. (It was surprising to find that all wires except the street car cables are underground.)

We had no machinery except one pitcher pump, which we made from a piece of 4" pipe, which could be used for pumping water from pockets in the sewer trench (although usually the water was removed by buckets); and two chain hoists which we borrowed from a ship yard and which we used in laying the larger pipe.

The sandy soil made excavation easy, slowed up only when we ran into sandstone. The sandstone was removed by picks and shovels, which it wore down rapidly; the strange thing being that it always wore them to a sharp point. Where the sewer depth exceeded four feet it was usually necessary to sheet the trench.

Due to the sandy soil and the fairly steep street grades and to the complete lack of a storm sewer system, it was necessary to backfill the trench and replace the cobblestone pavement as soon as possible to prevent complete erosion of the backfill and the undermining of the pipe.

The outfall sewer consisted of approximately 8,000 feet of pipe 60 to 100 centimeters in diameter, discharging into the Paraguay river at a depth of 15 ft. below normal water level. The complete sewer system for Asuncion will cost approximately $2,000,000. Most of it will be done by local officials and local labor, and

it seemed desirable to show them how it could be done by designing the system and constructing a part of it. Three thousand feet, including the under-water discharge pipe, 150 ft. of tunnel under a ship yard, and a siphon under a creek, was laid by day labor under the direction of Captain (now Major) John Greenleaf and the writer. The balance was done by contract. This was the first unit-price sewer work ever performed in Paraguay and was let to acquaint the people with this type of work. We advertised for bids, wondering if we would receive any, and were surprised to receive six, all well prepared and four of them not far apart and in line with our estimate of cost; the other two, however, were respectively 100% and 300% above the fourth bid. The work was awarded to a local contractor, who proved quite capable of handling it.

All the pipe used was portland cement concrete, made in Formosa, Argentina, about sixty miles away. It ranged in size from 20 cm to 1 meter in diameter. None of it was reinforced, but it is not subjected to very heavy loads (except in one or two locations and there it was given special treatment), and the soil was sandy, and with labor plentiful every inch of the backfill was well tamped. In fact, every shovel of backfill was spread and tamped, and if by chance a second shovel full fell on a first before it had been tamped, the tamping crew stopped while the backfiller jumped into the trench and spread it.

The larger pipes were very much out of shape, a few so much so that they could not be fitted together. Had the pipes been true cylinders we would, I am certain, have had the most perfect pipe laying job in the world; for the grade boards were set ten meters apart, and the pipe layers were very, very particular in trying to follow our instructions in regard to laying the pipe to exact line and grade. In fact, it usually took a conference of three or four of them to decide whether the pipe was exactly on the line and grade or should be moved a sixteenth of an inch in one direction or another.

The outfall sewer crossed two ship yards, each about 150 meters across, passing under ship ways on which rested ships some of which weighed 300 tons. In one yard the excavation was all in sandstone and the top of the 1-meter pipe came within 2½ ft. of the ground surface. One foot above the pipe we widened the trench 18 in. on each side and poured a slab of concrete 12 in. thick and heavily reinforced with old steel rails, spanning the trench. In the other yard the original line and grade would have placed the sewer in a soft, water-bearing sandy soil. When we were ready to lay the pipe there were several ships sitting across the sewer line, which the owner of the yard had no intention of moving to permit our laying the sewer, and we moved the line about 200 ft. up the hill, where the sewer would come into the sandstone and at sufficient depth to permit tunneling, being 20 ft. below the surface and with 4 or 5 ft. cover of sandstone.

Except for the sewer system we started in Asuncion, there are no sewer systems in Paraguay. Also there is no water system in any town, most of the people depending on cisterns for their water supply. Those who have no cisterns, and those whose cisterns are empty during dry weather, buy water from two-wheeled carts drawn by small donkeys. There are no distinct wet and dry seasons, the average rainfall of 52 in. a year being evenly distributed over the twelve months.

Other Construction Work

In constructing the health centers, all buildings were constructed with local materials so far as possible, and local architectural design was followed in its simpler form, but omitting most of the ornate work found in most of their designs. The building materials —brick, timber and roofing tile—are produced in small quantities and no large stocks are kept in hand. Window glass, paint and nearly all metals such as copper wire, galvanized pipe and pipe fittings, have to be imported, delivery following six to eight months after the order is placed. There is no iron, copper, zinc or coal produced in Paraguay, and very little cement.

Brick, which is used for the walls of all buildings, are approximately 11 x 6 x 3 in., but the dimensions often vary ½ to ¾ in. Plastered inside and out with mortar, the outside walls are 30 cm (about 12 in.) thick, and partition walls 7 to 8 in.

Roofs were of native unglazed tile supported on European-style timber framing. The trusses, built of the very hard native lumber, were designed for appearance and were heavier than necessary to carry the light loads imposed on them. All floors were of cement tile.

Rather than wait for months on orders to be shipped from the United States, we designed and made a large portion of our equipment in our own shops of available material. For hot water tanks we used old gasoline drums. A safety valve was made by filing off the threads of a standard valve and inserting a brass bushing, then adding a balance arm and an adjustable weight. Long-necked water faucets to be used in the health center were made by welding a valve to a piece of copper tubing, bending and shaping the tubing and then nickel plating the complete job. Very neat and adequate faucets were made in this manner. The elevated water tanks were built of reinforced concrete, strengthened with old rails cut up into strips, and were supported on brick piers.

We had sufficient galvanized water pipe in sizes from two inches down, but no fittings. We bought used fittings wherever we could find them; sometimes only two or three at a time would be all we could locate. We made a pipe bender and whenever possible we bent the pipe in order to save fittings. We also made a steam line from a one-inch galvanized water pipe. This also we had to bend for lack of fittings. When the line was completed we turned on the steam and held our breath, but to our surprise the pipe held, even under 150 pounds of steam. This pipe had been made in the United States.

The work on all our projects was done by local labor under local supervision. We found the people to be good workers; in fact, they were artists at brick and mortar work. Due to a shortage of work in the country, there was a marked tendency to slow up near the end of each project, but they could scarcely be blamed for that.

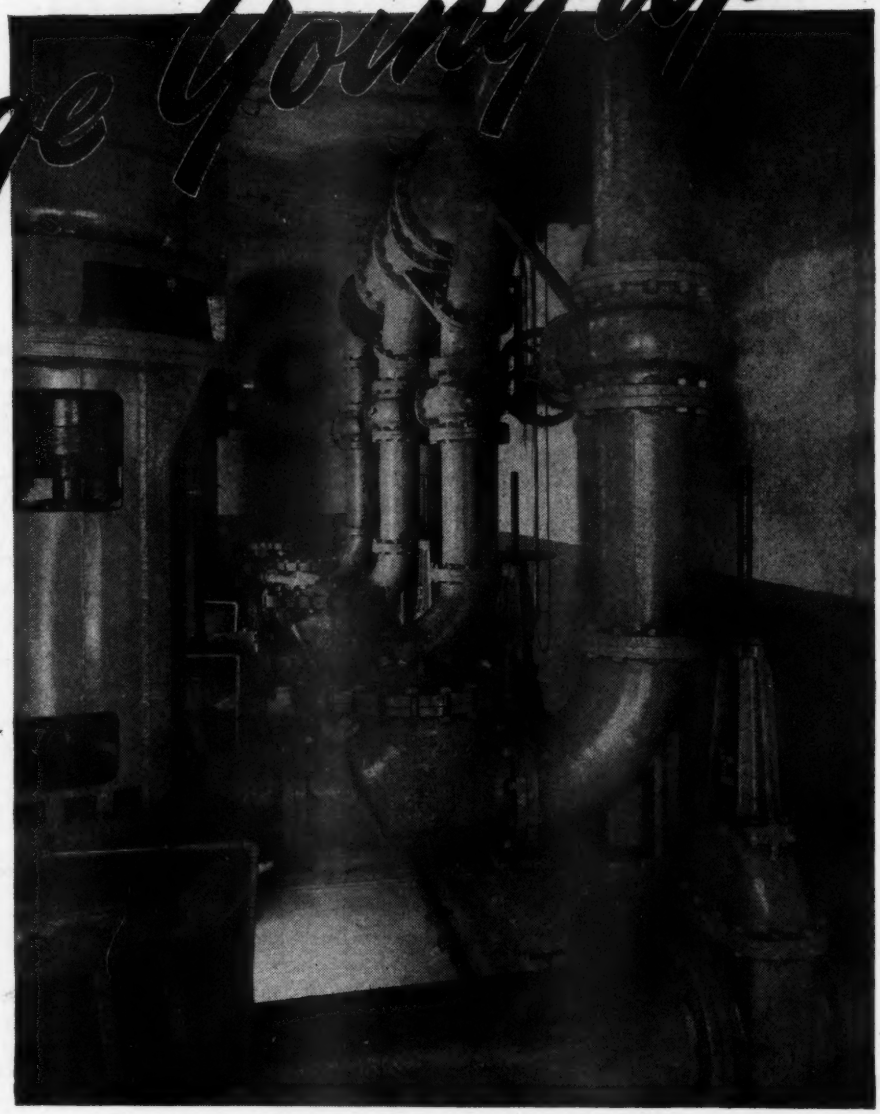
Airport Leased to Private Operator

Alliance, Nebr., has leased to a private operator the management of the hangar and other facilities at the municipal airport under a one-year contract which may continue in effect four additional years but may be terminated by 60 days' notice by either party. The agreement provides that the operator is to maintain facilities in good condition and will reimburse the city for any damages for loss of life or property or personal injury for which the city may be liable. The city is to receive 5 per cent of the gross revenue from the sale of gasoline and aviation supplies and 12 per cent of the gross revenue from all other operations.

Sewage Going Up AT CRANSTON, R. I.

Shown here is the battery of four pumps and valves at the Main Station, Pontiac Avenue, one of five sewage pumping stations already installed for Cranston's 53,000 citizens. The sewerage system project was planned for the future. It includes about 150 miles of sewers and service connections, seven sewage pumping stations, and complete sewage treatment works. Each centrifugal pump has two Ludlow 300 lb. Test Double Gate Valves (Outside Screw and Yoke Type) on suction and discharge connections, and a Ludlow Clear Opening Check Valve with Outside Lever and Weight in discharge piping. The system also employs Ludlow Sluice Gates.

Ludlow Valves and Sluice Gates assure peak efficiency, long life and a minimum of service requirements.



Suction and Discharge Piping with Ludlow Valves at Main Sewage Pumping Station — Pontiac Avenue, Cranston, R. I.
Two Pumps — 3000 gallons per minute, variable speed units.
Two Pumps — 3500 gallons per minute, constant speed units.

Fay, Spofford & Thorndike, Boston, Engineers
Yeomans Bros. Co., Chicago, Contractors for Sixteen Pumps
Ralph P. Hall, Inc., Boston, Subcontractors for Installations

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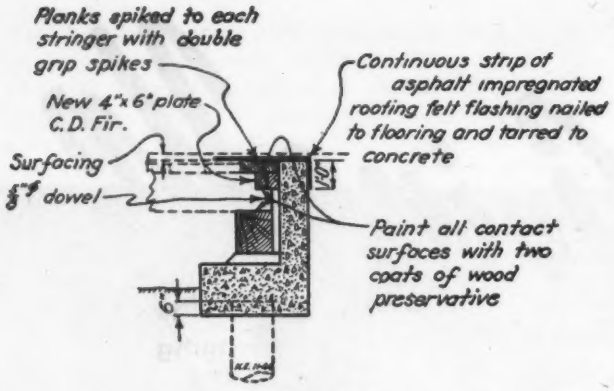

Planks spiked to each stringer with double grip spikes
New 4"x 6" plate C.D. Fir.
Surfacing
dowel
Continuous strip of asphalt impregnated roofing felt flashing nailed to flooring and tarred to concrete
Paint all contact surfaces with two coats of wood preservative

Fig. 2—Use of concrete for repairing decayed pile top.

Maintenance an ep

IN our February issue we described the methods employed by the Bridge Department of California's Division of Highways in maintaining the floors of its 4,636 bridges. Of this total, about 1,500 are timber bridges, most of them built by the counties before the roads were taken over by the State, and about 1,000 of these have timber bulkheads. The method of maintaining and repairing these 2,000 bulkheads is described in the following article.

Treated timber is used for the more permanent construction, and bulkheads built of this have given little trouble. Untreated timber has a short service life in the damp coastal regions, but in the drier valley and foothill regions has given fair service. In either case, bulkheads are subjected to heavy live load concentration, to erosive action of the stream, to shrinkage, checking and decay.

Impact may crush the caps, either between the stringers and piles or directly over the pile tops, generally due to decay at these points. Such decay can usually be prevented or delayed by painting contact surfaces with wood preservative or covering the pile tops with an impervious membrane or sheet metal. The floor system above these points should be so constructed as to keep rain water from them.

Bridging between stringers over abutment caps using pieces with the grain placed vertical will give trouble when the stringers shrink, forcing upward the flooring that rests on the bridging pieces and admitting decay-producing moisture. This can be avoided by cutting the bridging pieces a little shorter, or placing them with the grain horizontal, using herringbone bridging, or using dowels from stringer to cap as a substitute for bridging.

Checking of timber in piles or dimension members admits water, with resulting decay. Spraying checks with a wood preservative may or may not be worth while. The problem is a difficult one.

Decay fungi develop with suitable conditions of moisture, air and temperature. Wood continuously dry or wet does not decay. Contact with earth is especially conducive to fungi growth. Such contact is found at the following locations:

(1) bulkhead planks and approach fill, (2) stringers and flooring, (3) stringer ends and bulkhead planks, (4) stringers and top of caps, (5) top of piles or posts and caps, (6) caps and bulkhead planks, (7) piles or posts and bulkhead planks. Correction of trouble due to decay at these locations is often difficult and expensive.

Much of this decay can be prevented by painting all contact surfaces with two coats of wood preservative. But painting all sides of a timber member may prevent drying and promote decay. Bulkhead planks can be protected by placing building paper between them and the soil, using two layers of paper, each well brushed with tar or asphalt.

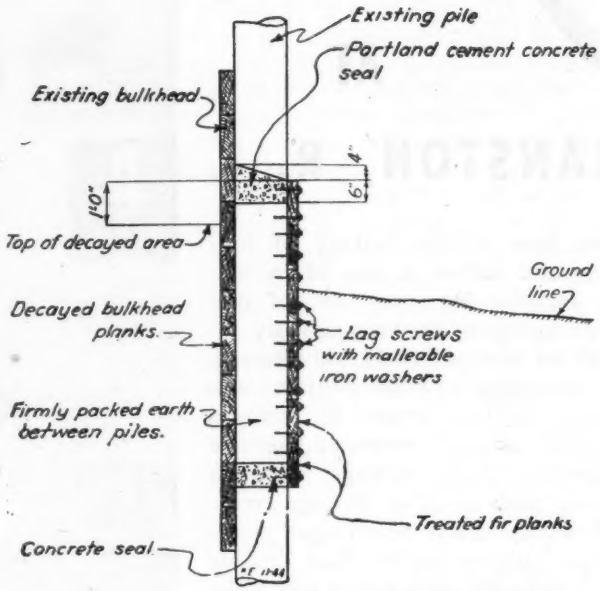


Fig. 1—Method of strengthening decayed bulkhead.

Weakness due to decay in bulkhead planks can be corrected by lag-screwing treated planks onto the outer faces of existing piles and filling the space between the old and new planks with sand. (See Fig. 1).

Decay between stringers and flooring directly over caps will cause looseness at this point and admission of moisture, resulting in rapid decay. This can be avoided by use of a membrane, as shown in Fig. 2. If such decay occurs, a supplemental timber bent could perhaps be constructed in front of the old one, the decomposed sections of the stringers be cut out and the remaining good timber insulated from the earth before backfilling. Decaying timber should always be removed. If many stringers are decayed it may be economical in the end to replace all the stringers and decking at once. Either is an expensive and troublesome operation. If replacement of the entire bulkhead is necessary, new types of abutment may be considered, such as concrete.

Concrete may be used in repairs, one method being shown in Fig. 2. This may be built directly on old pile stubs if these are in condition to give the desired support. Note the small pedestal support for the cap; this reduces the area of contact surface between concrete and timber and allows room for the accumulation and easy removal of small amounts of debris. The

an epair of Timber Bridge Bulkheads

How the California Division of Highways delays decay in bridge timbers and replaces decayed or decaying sections, thus prolonging the life of the structure.

space between ends of stringers and back walls allows air circulation, and the continuous asphaltic membrane gives protection against moisture infiltration. While making such construction, traffic can be carried temporarily by cross-overs—salvaged 6" planks long enough to span a 6 ft. opening in the flooring, built into 3-plank units for ease of handling.

Fig. 3 shows a type used extensively where treated timber piling and the stringers and flooring were in good shape, but the bulkhead planks and caps badly deteriorated. Note clearance at stringer ends and caulking at joint to prevent admission of water—important items for preventing decay.

Fig. 4 shows a type of construction used for completely replacing a bulkhead. Construction can be completed up to the bottom of the stringers before any portion of the traveled way is disturbed. After pouring footings, a form can be placed against the outer faces of the posts and the space behind it filled with sand, the form for the front placed and the concrete poured. Concrete wings can be completed at the same time. A short section of the concrete deck and approach roadway slab is removed for half the width of the roadway; also the old cap. Corrugated sheet metal backing is placed to protect the ends of the stringers and give circulation of air. Then the new concrete road surface is constructed; and, when this is ready to carry the traffic, the same procedure is followed for the other half of the roadway.

These repairs are relatively expensive and cause

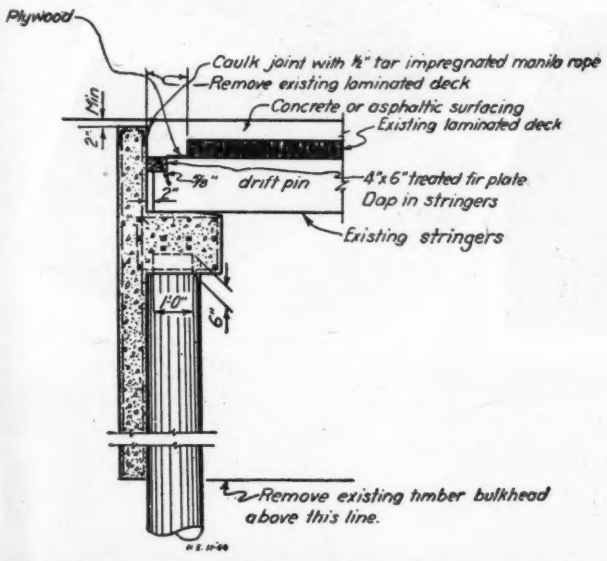


Fig. 3—Repairs where bulkhead planks and caps are badly deteriorated.

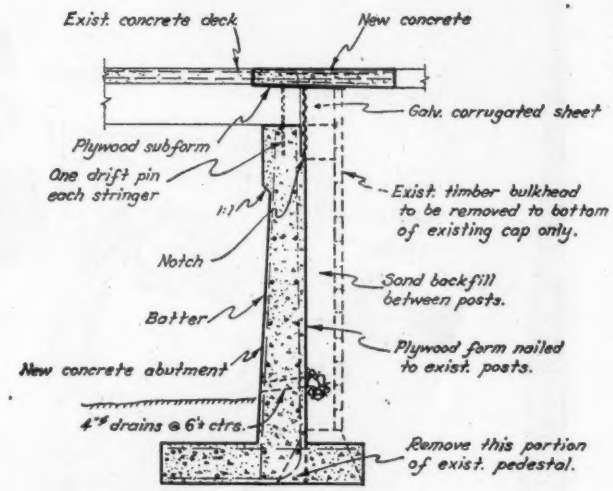

Exist. concrete deck
New concrete
Galv. corrugated sheet
Plywood subform
One drift pin each stringer
Exist. timber bulkhead to be removed to bottom of existing cap only.
Notch
Sand backfill between posts.
Batter
Plywood form nailed to exist. posts.
New concrete abutment
4" drains @ 6' ctrs.
Remove this portion of exist. pedestal.

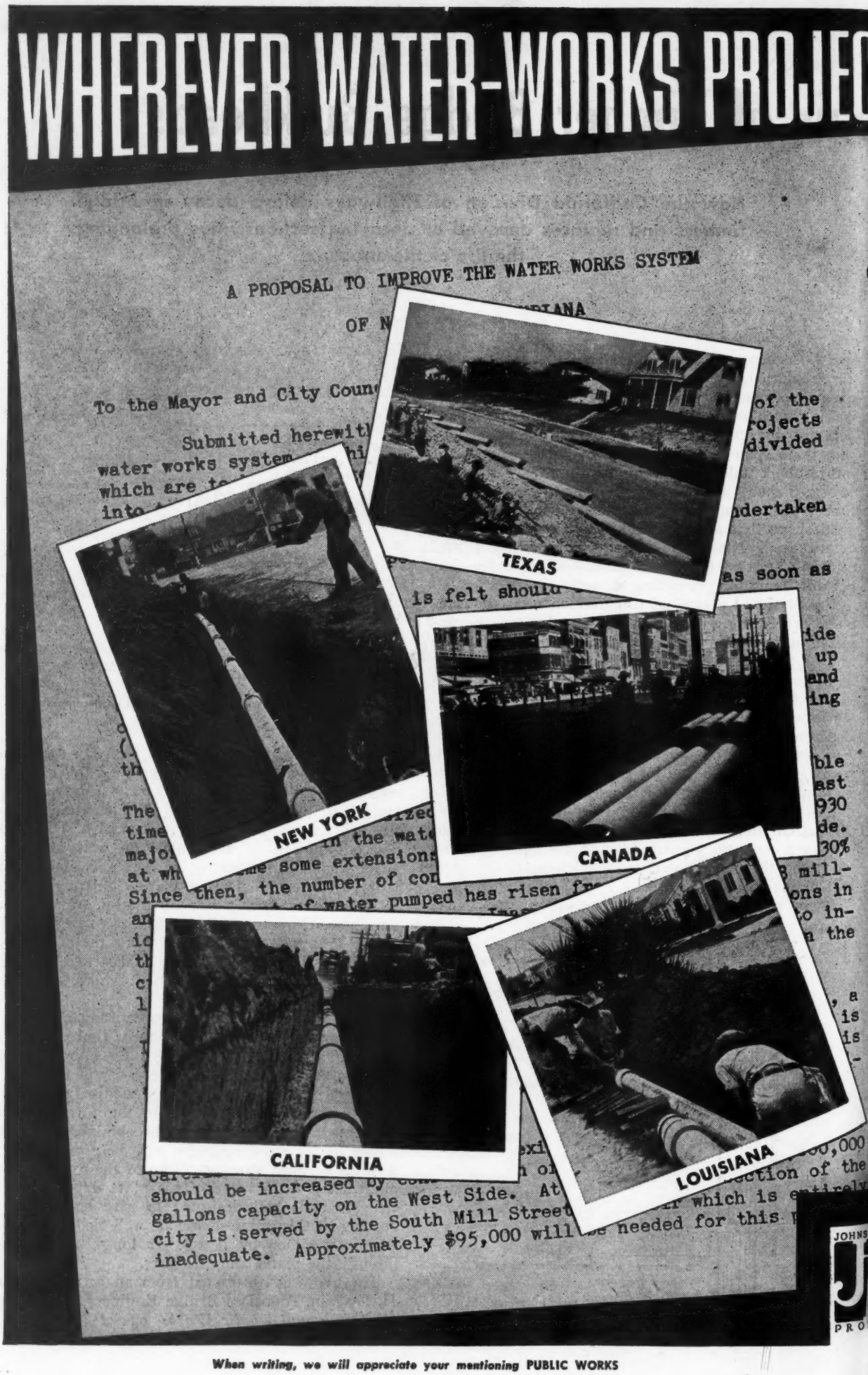
Fig. 4—Replacing timber bulkhead with concrete.

inconvenience to both traffic and highway department. To a large extent they can be avoided by proper construction and maintenance. During construction the ends of stringers and caps and all other timbers should be well treated with wood preservative. Dirt should not be allowed to accumulate in and around the stringer and cap supports, as it retains moisture and is the direct cause of decay there. Construction should be such as to permit free circulation of air around the ends of stringers, as by use of corrugated sheet metal. This should be bent over onto the flooring, and the end resting on the flooring be flattened out so that there can be no springing action, which would cause break-up of the surfacing.

The joint between the bridge end and approach fill is a weak and vulnerable point in timber deck and bulkhead construction. The need for impervious construction at this location and necessity of resisting the high impact force occurring here, requires good, sturdy detail if the desired results in the form of watertightness and rigidity are to be obtained. Some substitute for an end diaphragm must be provided for the flooring between stringers. Two of the figures show a plate about 4 x 6 inches. This plate dapped into the stringer ends and designed to give support to the flooring at this point should be well tied down to the stringers, either by dowels or long diagonal bolts through the plates and stringers.

The above is abstracted from an article by Merle H. Godwin, Associate Bridge Engineer, in *California Highways and Public Works,* official journal of the Division of Highways.

WHEREVER WATER-WORKS PROJECT



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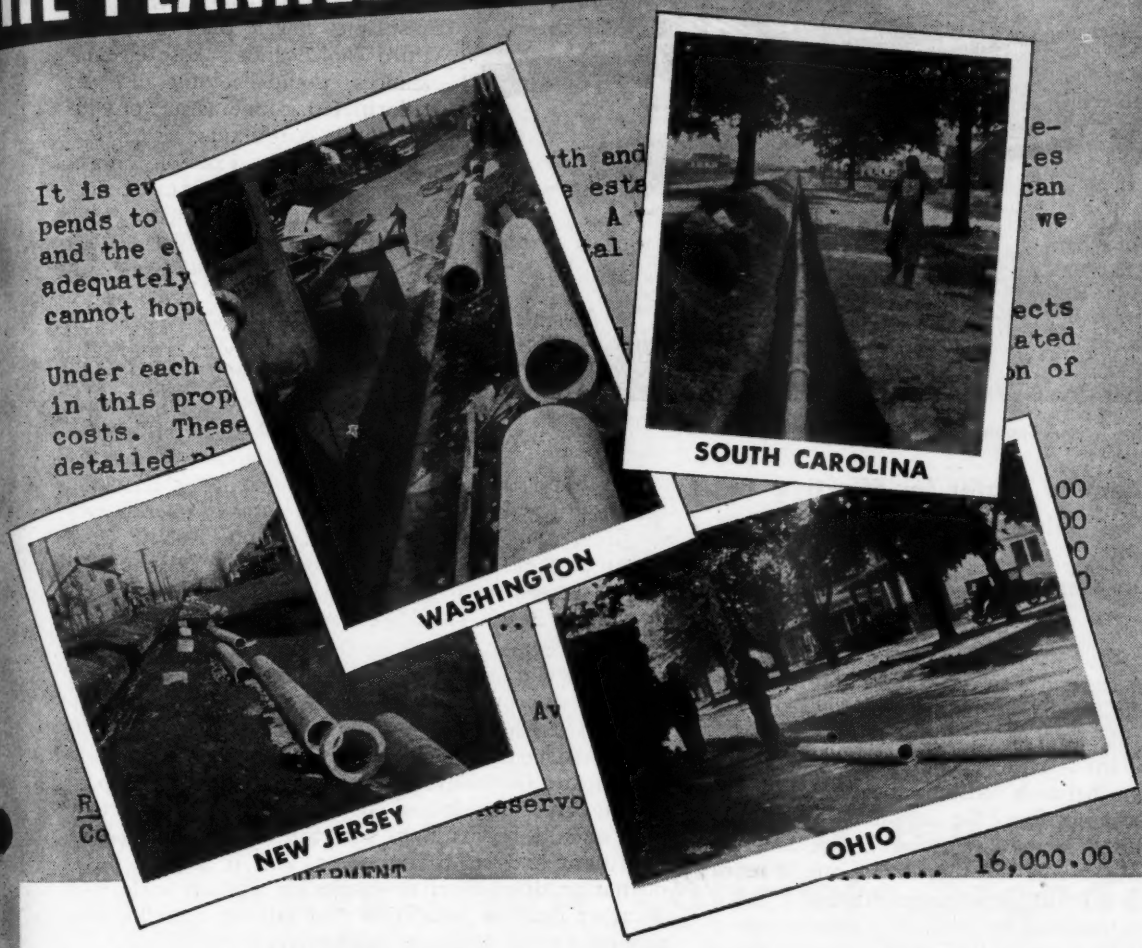

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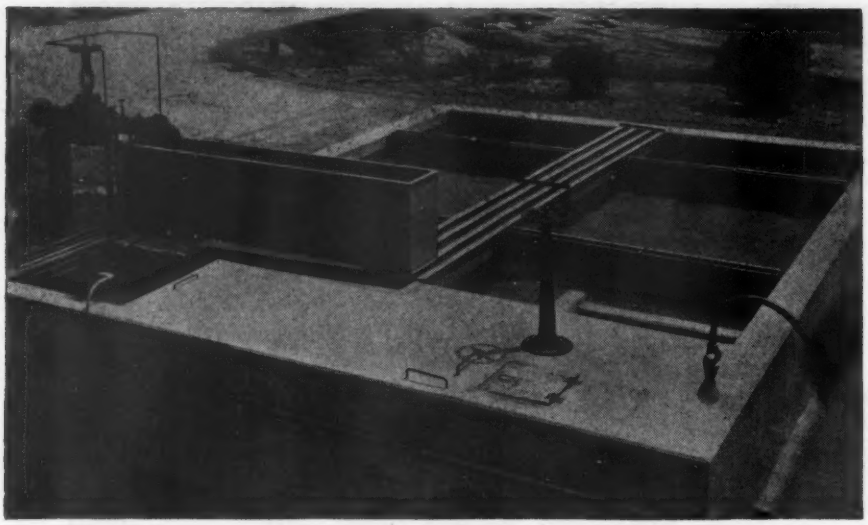

A Spaulding Precipitator installation.

Pretreatment of Water for Effective Filtration

(Continued from page 25)

ulant treatment. Still another process consists of the reaction between sodium silicate and ammonium sulphate, chlorine or carbon dioxide to produce the desired colloidal silica, which is applied to the supply before the coagulant is added. The fourth process involves the reaction between sodium silicate and a portion of the coagulant dose, the colloidal silica thus formed being added to the raw water before the rest of the required coagulant. Whether or not one or more of these processes will aid in the coagulation of a given supply must be determined by trial. Any demonstrated improved coagulation secured by using one of these procedures usually includes the rapid formation of a large tough floc, even when the water is cold and relatively clear. Detailed directions for each process must be followed. Space limitations prevent a more detailed discussion.

The application of the data summarized above may be indicated by the following examples:

Let it be assumed that a clear, cold water forms only a "smoky" floc with alum, irrespective of the dose of alum used on a plant scale. Under these circumstances the difficulty is likely to be incidental to the low temperature of the water in the absence of appreciable suspended solids. Therefore, one of the adsorptive clays might be added to form artificial turbidity of a flocculant character, or a small dose of sodium aluminate might be added with the alum to hasten coagulation under cold water conditions. In many instances, however, improved coagulation can be secured by using a higher-than-usual dose of alum provided an overdose does not unduly depress the pH value of the treated water. Therefore another factor to test is the need for added alkalinity in the form of lime or soda ash.

Another example might be a highly colored, soft water. As coloring matter frequently is a complex compound of iron and organic matter, heavy chlorination may oxidize the iron and very materially assist in coagulation of the color by normal doses of alum. If such is found to be ineffective, however, improved coagulation with alum might be secured by adding a small dose of sulphuric acid to depress the pH value, the sulphate ion of the acid producing conditions favorable for the formation of the color floc at the resulting lower pH values. A third choice under these circumstances would be the use of chlorinated copperas or one of the ferric coagulants.

Still another example might consist of water containing sufficient algae to produce a very light, poorly settling floc so that the filter beds become over-loaded and short filter runs result. Ordinarily effective copper sulphate treatment will avoid this difficulty; but if it does not, then prechlorination or copper sulphate treatment of the influent of sedimentation basins to destroy algae would be the best solution. Powdered activated carbon also will suppress algae growths in open basins by preventing the penetration of light. In any case, the algae should be destroyed because dead algae cells are more readily coagulated than living cells, or their growth in basins should be prevented.

A final example might be that of delayed floc formation, whereby sedimentation is very poor and most of the floc is formed in the filter beds or even is precipitated in the filtered water basins or clear wells. This is an extreme example of poor pretreatment and usually indicates ineffective use of coagulant as well as poor mixing and flocculation. In this instance, laboratory tests should be made to ascertain the most effective coagulant and coagulant doses, and if similar doses do not produce effective results on a plant scale it is a rather definite indication that mixing and flocculation on a plant scale are ineffective.

Corrective action in this case, of course, would be to install improved plant facilities for mixing, flocculation and possibly sedimentation.

Mixing and Flocculating

Most of the early mechanical or rapid sand filtration plants did not include mixing or flocculating basins, as the distribution or mixing of the chemical throughout the water was assumed to occur in the low-lift pumps or in channels through which the coagulant-treated water flowed towards the sedimentation basins, and also because coagulation was assumed to occur under quiescent conditions obtaining in the sedimentation basins which therefore were termed "coagulating basins". Since about 1921, however, attention has been directed towards the use of mechanically operated paddles or agitators to secure gentle agitation, which was found to favor the formation of floc without the agitation being sufficiently violent to break up previously formed floc. More and more attention, therefore, is being given to flocculating basins because it is now realized that well flocculated water may be readily settled and filtered, whereas improperly flocculated water does not benefit materially by prolonged sedimentation. In fact, experience focuses attention upon the necessity of effectively pretreating water before filtration rather than expecting the filter beds to complete otherwise poor coagulation by contact action in the beds.

Improved pretreatment has improved filter opera-

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tion by reducing the amount of material removed by the filters and has reduced the amount of wash water required. Furthermore, effective pretreatment permits the use of coarser filter sand or anthrafilt than otherwise would be the case, which in turn prolongs filter runs and facilitates washing. Probably the most important aspect of improved pretreatment so secured is the possibility of operating filters at somewhat higher rates than the conventional 2 g.p.m. per sq. ft., so many of the recent filtration plants are specifically designed to benefit by this situation. The higher rates are not feasible, however, unless the whole plant is designed for this purpose.

For reasons stated above, mixing and flocculation should be considered as separate steps in the treatment process. Mixing or the distribution of the coagulant may be secured through the agency of low lift pumps, rapidly revolving paddles or propellors, aerators, the use of compressed air in water conduits, the "hydraulic jump" or properly proportioned baffled mixing basins. Generally speaking, flash mixing should be secured by rather violent agitation for a matter of a few seconds, so as to distribute the coagulant without prolonging the violent agitation sufficiently to interrupt any incipient floc formation.

Flocculating or conditioning basins consist of baffled basins through which water flows with perceptible but not violent agitation; or basins fitted with slowly revolving paddles or patented agitators which result in turbulence throughout the whole volume of the basin; or finally, basins where spiral flow produces agitation through the energy of the entering water.

Each type of flocculating basin has certain advantages and disadvantages. The baffled basin insures agitation of all portions of the water being treated, but the degree of agitation depends upon the relative size of the basin and baffle spacing (which are fixed) and the rate of flow of water through the unit. Therefore, the degree of agitation fluctuates with the rate of flow and cannot be modified at will to compensate for changes in the quality of the water being treated.

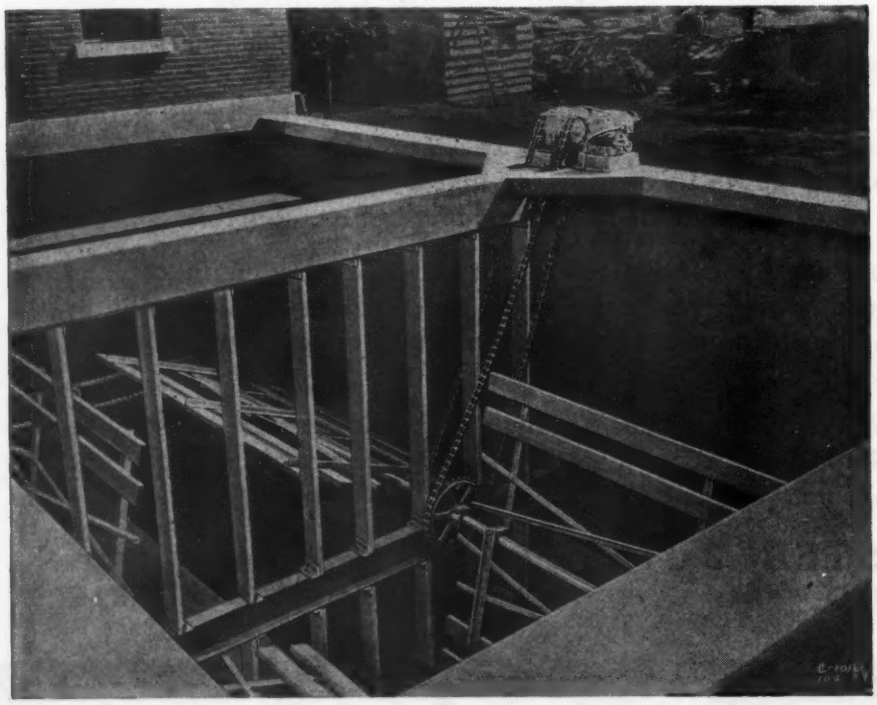
Basins fitted with mechanical agitators, therefore, have the advantage of controlled agitation, secured by changing the speed of the mechanism; but unless inlets and outlets are carefully designed, there may be a tendency for a portion of the water to pass through these basins very quickly. Mechanical flocculators may be installed at existing plants to provide needed agitation, such as by placing the paddle mechanism in the first portion of existing sedimentation basins. Furthermore, the effective agitation of small supplies with mechanical means may be provided over the required period of time without excessive loss of head, which is in contrast to baffled basins where friction losses at rates of flow required to produce agitation for the needed flocculating period becomes excessive and impractical. For instance, agitation for only 10 minutes with a rate of flow of 1 foot per second requires baffled channels 600 feet long. In fact, it was this situation which led to the use of small paddle agitators or laboratory mixers for use in the laboratory to control coagulation.

Spiral-flow basins require only about 1 foot loss of head to give a resulting velocity of 0.5 to 0.75 ft. per second, so these basins are adaptable for installation at existing plants where flocculation is deficient. The degree of agitation, however, is not subject to much control, and varies throughout the basin and with the rate of flow.

Agitation through the use of air has not been generally used in water plants, but experience demonstrates that controlled agitation may be secured in this manner. This method is adaptable for use at existing plants where flocculation may be inadequate, and also where aeration is needed during freezing weather, when conventional aerators cannot be used.

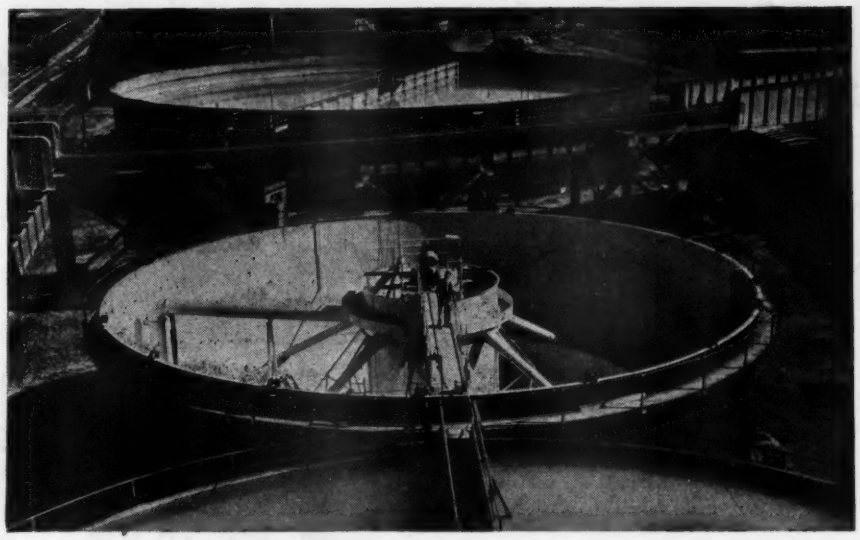
The power required for mixing and flocculation is quite small. A loss of head of between 1 and 3 feet is usually sufficient to cause the flow resulting in the desired agitation in baffled mixing basins, this being equivalent to about 1/4 to 1/3 H.P. per million gallons of water treated. Motor-driven mechanical agitators usually require about ¼ H.P. per million gallons of flow. The power required to operate air compressors used with air agitation is considerably greater than these values, but this disadvantage is not so important where agitation with air may be used also to secure aeration.

The degree of agitation required is of basic importance. Numerous studies have demonstrated quite conclusively that the degree of agitation equivalent to a rate of flow less than 0.3 foot per second is inefficient and results in the deposition of floc in the flocculation basin. Velocities in excess of 1½ to 2½ feet per second, while securing rapid flocculation, lead to the disruption of the floc as formed. Best results, therefore, are secured with agitation equivalent to a flow of between 0.6 and 1.2 feet per second in baffled basins, or with mechanical agitator speeds giving this average velocity to the water.



Rex "Slo-Mixing" equipment at Ottawa, Kans.

The required flocculating period is directly related to the degree of agitation, although the time required for flocculation also is determined by the temperature and character of the water. In view of the fact that the temperature of water cannot be controlled, a flocculation period should be selected to meet the less favorable cold water conditions. The ultimate design should be based, when feasible, upon laboratory flocculation studies, or preferably by the operation of a pilot plant. In general, however, designers are using longer and longer flocculation periods because they have discovered that effectively flocculated water can be settled in smaller sedimentation basins, so that the overall size of the treatment works is reduced. The tendency, therefore, is to provide flocculation periods of from 20 to 60 minutes, although many of the older plants have periods of 5 to 15 minutes.



Battery of Infilco accelator clarifier softeners, 6,000,000 gpd.

The operation and control of flocculating basins is basic to the effective operation of filter beds. As stated, properly flocculated water contains well developed floc particles suspended in practically clear water. Frequently the floc, however, is so fragile that it is broken when a sample of water is collected for examination. Therefore the best means of determining the adequacy of flocculation is through the use of submerged lights in the effluent end of the basin or in the channel conducting flocculated water to the sedimentation unit, and by the ease by which the water may be filtered.

Laboratory mixers also may be used in comparison with full-scale flocculating basins to disclose deficiencies. These laboratory mixing units are so small, however, that hydraulic conditions are entirely unlike the full-scale unit, so that there is no simple relationship between the speed of operation of small paddles or propellers in glass beakers, etc., and large-size mechanically operated agitators or the rate of flow in baffled basins. The so-called "Model Law" helps in relating the dimensions and hydraulic conditions of small units to full scale units, but normally this refinement is not necessary, except when a pilot plant is being designed. The degree of agitation used with the laboratory mixer should be modified by trial-and-error until satisfactory flocculation is secured on a laboratory basis with a reasonable period of agitation. Any great superiority over the results secured with an existing full-scale unit indicates an inherent inadequacy. The problem then is to determine whether the deficiency of the large basin is one of degree of agitation or of period of agitation.

Improvement might be secured by adjusting the spacing of baffles or by modifying their shape and position, or the speed of mechanically operated paddles, or by replacing antiquated mixing equipment with mechanically operated equipment providing the required degree of agitation, or by the use of compressed air to increase agitation in existing basins.

Sedimentation

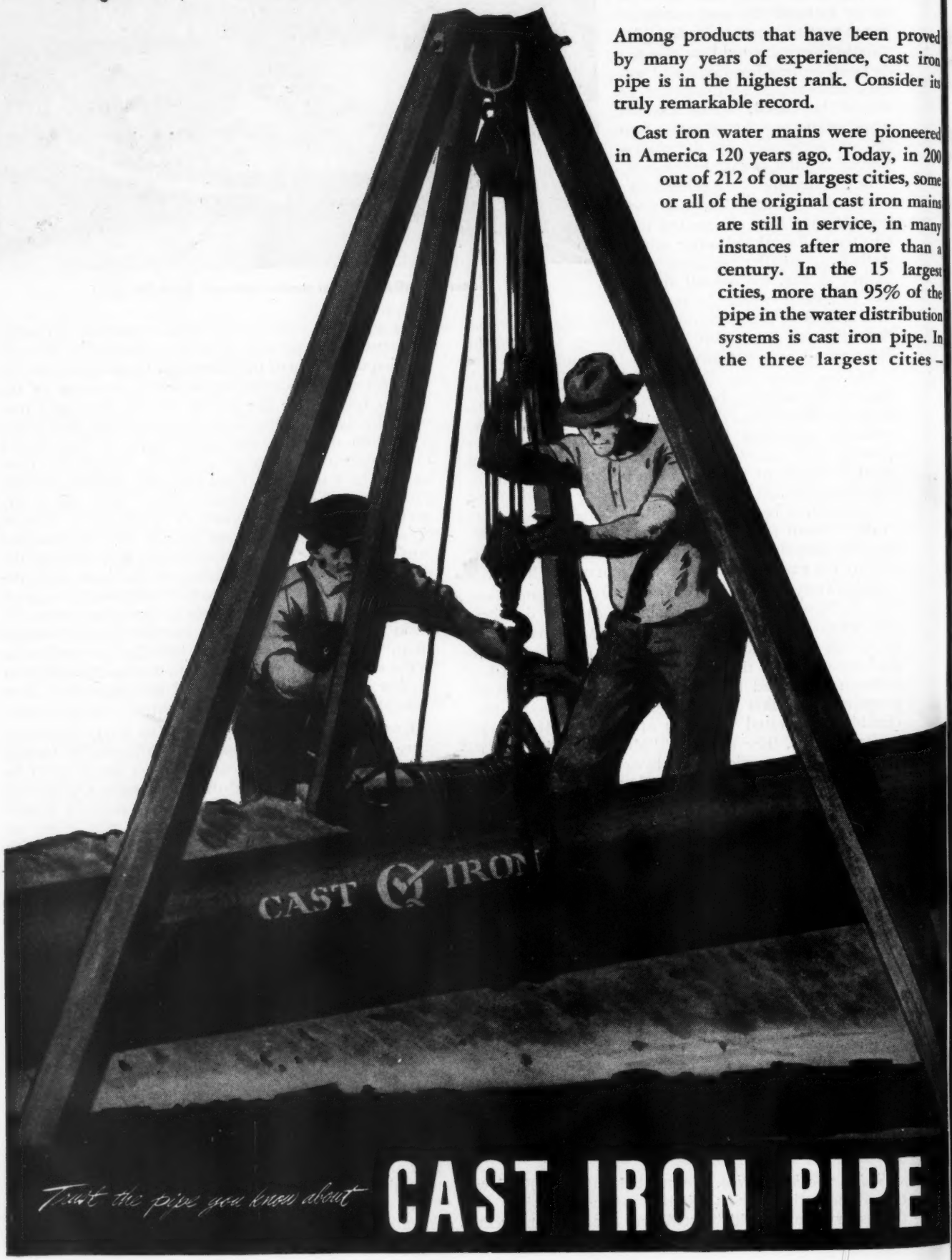
Sedimentation Basins. Flocculated water should flow to sedimentation basins without undue agitation, so flumes or pipes should be sufficiently large to prevent velocities in excess of 2 feet per second. Many existing filter plants are deficient in this connection. Possibly the most important feature of a sedimentation basin is the shape and size of the inlets and the methods used in preventing short-circuiting or eddy currents in the basins. Experience has shown that the best, and possibly the simplest, procedure is to discharge flocculated water into an inlet channel or chamber at right angles to the subsequent direction of flow in the sedimentation basin. The water flows from this inlet channel into the basin through a perforated stilling wall where the perforations are so designed as to provide a velocity of about 0.4 to 0.8 foot per second. The friction loss thus introduced tends to equalize the flow through the various openings in the stilling wall. Even then, the entering water is inclined to flow diagonally through the openings in the stilling wall. Therefore, when the basin is sufficiently large to warrant further refinement, "training walls" may be installed perpendicular to the stilling wall and parallel to the desired direction of flow, so that all portions of the water will flow through the basin without strong eddies being formed.

Even with careful preparation in inlet structures, there is a definite tendency for eddies to be formed which result in short-circuiting. This is likely to be more serious when "round-the-end" baffles are used to reverse the direction of flow of water through a sedimentation unit. Best results, therefore, usually are secured through the use of one-direction flow through a rectangular basin with a length two to three times the width. The best depth of the basin would depend upon other dimensions, but usually should not be less than 10 to 14 feet, so that sludge storage space is provided. Basins that are too deep in proportion to their area, however, are not so effective because the path of settling solids becomes that much greater and water may reach the effluent end of a deep basin before the solids have reached the bottom.

Settled water usually is taken from the surface at the outlet end of sedimentation basins over skimming weirs. These should be submerged below the flow line of outlet channels so the residual floc is not broken by a free fall.

Temperature stratification may introduce complications because the entering cold water may sink and flow along the lower portions of a basin, or warm water may flow near the surface. These difficulties can be overcome by the use of an entrance channel or chamber extending for at least one-half the depth of a basin and a stilling wall as described to insure the entrance of

Lay it with Confidence



Among products that have been proved by many years of experience, cast iron pipe is in the highest rank. Consider its truly remarkable record.

Cast iron water mains were pioneered in America 120 years ago. Today, in 200 out of 212 of our largest cities, some or all of the original cast iron mains are still in service, in many instances after more than a century. In the 15 largest cities, more than 95% of the pipe in the water distribution systems is cast iron pipe. In the three largest cities –

Based on Experience

New York, Chicago, Philadelphia—the ratios are respectively, 97%, 99% and 98%. Thus it is evident that top-flight engineers *continue* to endorse the judgment of four generations of water works men.

Confidence, based on experience, is doubly important in the case of pipe to be installed underground for distribution mains. They represent the major investment in a water supply system. So we say *—trust the pipe you know about.*

Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, Peoples Gas Building, Chicago 3, Ill.

THE 10 REQUIREMENTS FOR UNDERGROUND MAINS UNDER NORMAL CONDITIONS

LONG LIFE: In evaluating bids, the useful life of cast iron pipe is figured at 100 years minimum.

CARRYING CAPACITY: The carrying capacity of standard tar-coated cast iron pipe remains practically unimpaired for centuries. For the certain areas where tuberculating water is encountered, cement-lined cast iron pipe is available. Under such conditions, no other material offers the combined long life and sustained carrying capacity of cement-lined cast iron pipe.

TIGHT JOINTS: For *ordinary* pressures, cast iron bell-and-spigot pipe—for *high* pressures, cast iron mechanical joint pipe—are known to be leak-proof.

TENSILE STRENGTH: When tested under hydrostatic pressure to destruction, the ultimate tensile strength of cast iron pipe is a minimum of 11,000 p.s.i. for pit cast pipe and a minimum of 18,000 p.s.i. for cast iron pipe made by other methods.

BEAM STRENGTH: Under beam stress tests, 10 ft. span, standard 6" cast iron pipe sustains a load of 15,000 pounds and bends approximately one inch before breaking.

TOUGHNESS: Under hydrostatic pressure and the impact of a 50 lb. hammer, standard 6" cast iron pipe does not crack until the hammer is dropped four feet.

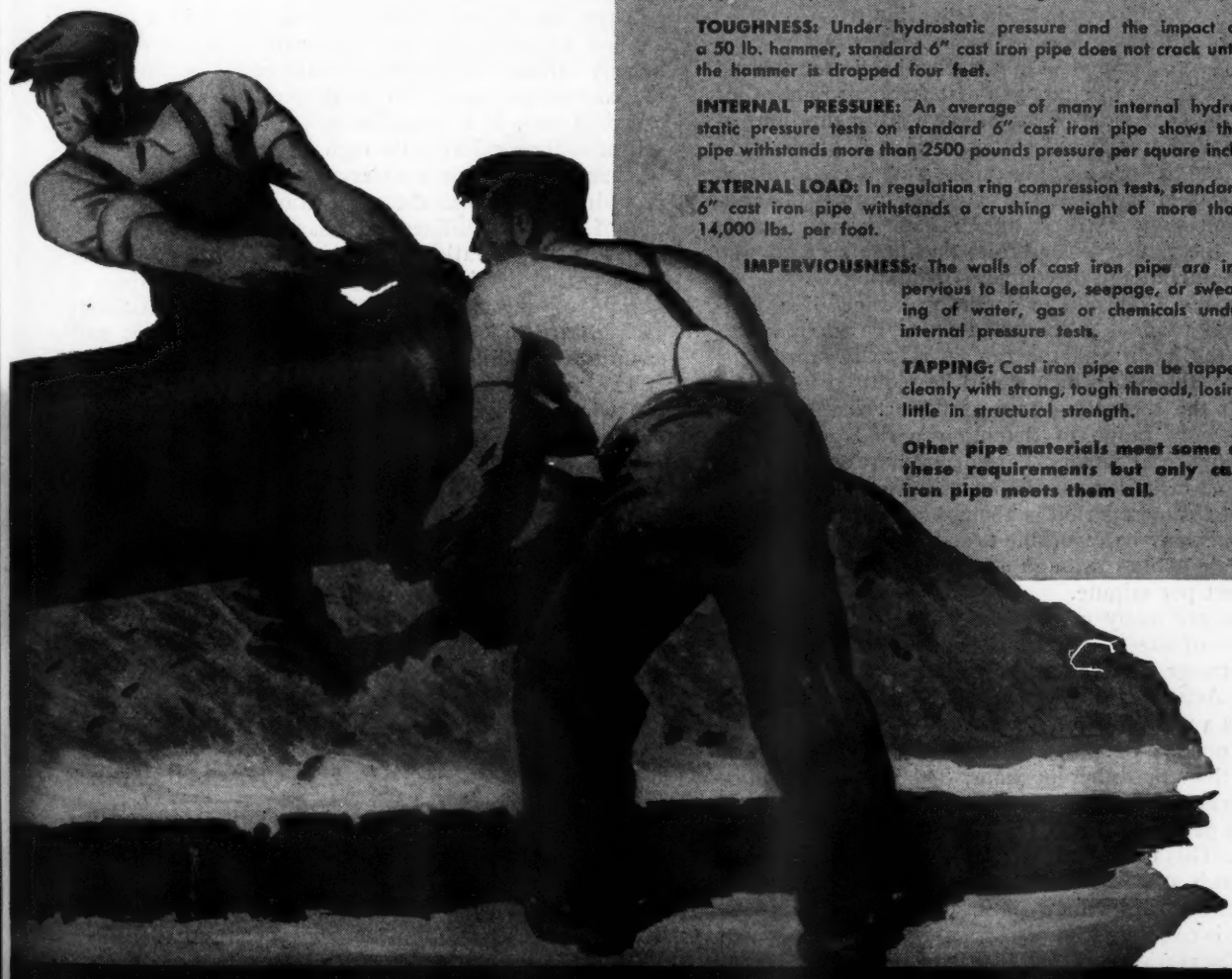
INTERNAL PRESSURE: An average of many internal hydrostatic pressure tests on standard 6" cast iron pipe shows this pipe withstands more than 2500 pounds pressure per square inch.

EXTERNAL LOAD: In regulation ring compression tests, standard 6" cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

IMPERVIOUSNESS: The walls of cast iron pipe are impervious to leakage, seepage, or sweating of water, gas or chemicals under internal pressure tests.

TAPPING: Cast iron pipe can be tapped cleanly with strong, tough threads, losing little in structural strength.

Other pipe materials meet some of these requirements but only cast iron pipe meets them all.



SERVES FOR CENTURIES

Tax Saver, No. 1

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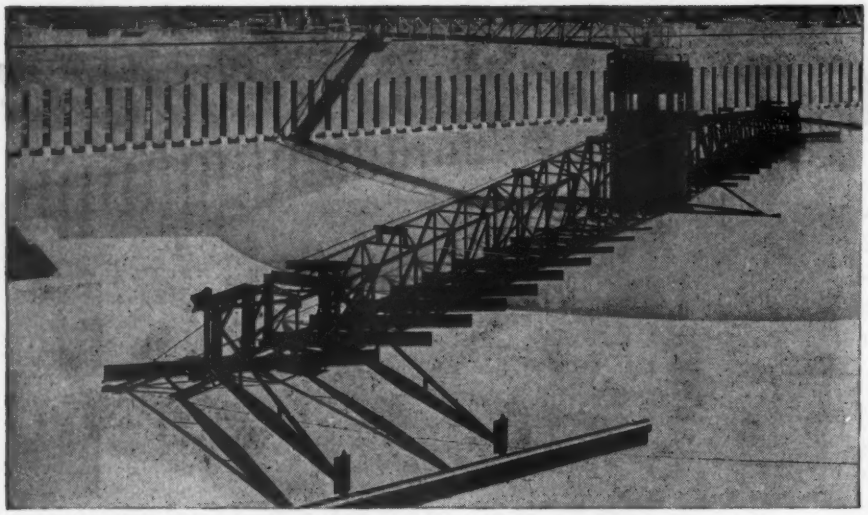

Mechanism of Dorrco "Squarex" clarifier at Kansas City water works. Flocculator in adjoining interconnected tank.

water over a sufficient depth. This in turn results in quiescent mixing and temperatures are equalized. The temperature of the water influences sedimentation more than the specific gravity of the settling solids, because of the higher viscosity of cold water. This influence is exerted just when low temperatures affect coagulation, so basin design should be based upon the less favorable conditions prevailing in winter.

Sludge Collection and Removal. Usually 25% capacity of conventional sedimentation basins is reserved for the collection of sludge so that frequent removal of the sludge is avoided. The effective sedimentation capacity, therefore, should be based upon the remaining 75% of the basin. If highly turbid waters are involved, mechanical sludge removal equipment may be advantageous. In addition, the use of this equipment permits the return of sludge to the incoming water to meet the advantage of contact coagulation.

Detention Period. The detention period of a sedimentation basin is a computed value based upon the size of the basin and the rate of flow. It represents, therefore, the time which would be required to fill the basin at the prevailing rate of flow. Existing basins have a wide range of detention periods depending upon many local factors. Periods as short as 1½ hours to 2 hours or as long as 10 hours have been used, but the most common period is about 4 hours. In order that conditions may be favorable to sedimentation, the computed rate of flow through a basin usually is less than three feet per minute.

There are many misconceptions regarding the significance of the computed detention period and as to the character of the flow prevailing in sedimentation basins. Actually, water does not flow through such a basin as a uniform body, even with effective design, so that a portion of the water reaches the outlet much sooner than the other portions. The computed detention period, therefore, does not represent the actual average period required for the water to pass through a basin. This may be demonstrated through the use of a dye such as potassium permanganate to disclose the progress of the dyed water through a basin at a time when it is convenient to discharge the effluent to waste. Such observations have shown that a portion of the dyed water may flow through a basin in a period as short as 15 minutes, whereas other portions of the dyed water may remain in the basin for many hours. The use of dye also discloses the actual path followed by the currents of water in the basin and conversely discloses those portions of the basin where counter currents or dead areas may prevail.

Observation of flow conditions also may be made with confetti. A small amount of the confetti is added to the inflowing water for a short period of time and the passage of the material through the basin can be observed quite readily. The three-dimensional effect of the confetti in water is useful in observing deep flowing eddies which are not so apparent when dye is used.

Still a third procedure is the use of submerged floats with a small rod or flag projecting above the water surface. Such floats, however, are only influenced by appreciable currents in their immediate vicinity and are not influenced by vertical currents which may lead to serious eddies and short circuits in other portions of the basin. Floats are most useful therefore in studying currents in large basins or open reservoirs. In any case, the above procedures are not feasible with covered basins unless a number of openings exist through which to make observations.

These limitations do not apply to the most accurate method of studying flows in sedimentation basins, namely through the use of salt. Inasmuch as the chloride content of water can be determined by a simple chemical test, it is possible to study the passage of salt or sodium chloride through a basin more accurately than by the visible observations noted above. The procedure consists in the application of a strong solution of salt to the influent of a basin in a dose sufficient to give a concentration of chloride of about 300 p.p.m., for a period of about 5 minutes. At the same time, a sample of the effluent is collected and additional samples are collected at intervals of five minutes and examined for chloride content.

The chloride content of these samples will disclose (a) when salt first reaches the outlet end of a basin; (b) when the maximum concentration of the salt reaches the outlet end and finally (c) when the last trace of the added salt has disappeared and the chloride content of the effluent returns to normal; that is, to the value of the chloride content of the untreated influent.

The most accurate method, however, is to use electrical equipment for measuring the conductivity of the effluent, which value is materially influenced by the presence of salt in the water. The equipment is calibrated in terms of chloride content, and thus will give direct information at more frequent intervals than it is possible to make the chemical test for chlorides.

These results secured by chemical tests or conductivity measurements, however, are capable of much more precise interpretation if the values are plotted on coordinating paper. The procedure is to plot the chloride content of the series of samples of the effluent as vertical values or ordinates on the paper, each value being plotted for the appropriate time period when the specific sample was collected as measured on the horizontal abscissa or time axis. The series of points on the coordinate paper are then connected by an irregular line or curve. The shape of the area under the curve discloses the flow characteristics. The "center of gravity" of this area represents the point where one-

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Close to our fighting lines in many parts of the world, Aqua Nuchar Activated Carbon is functioning in the same way it operates in communities all over America . . . it is removing tastes and odors by adsorption to make water more palatable.

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When our armed forces employ Aqua Nuchar, they are using the same purification principle that waterworks engineers all over America have endorsed for many years.

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Investigate Aqua Nuchar . . . the activated carbon that makes possible the delivery of palatable water!

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But above all, remember there is a war yet to be won. Maintain equipment to assure operation at 100% efficiency.

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half of the added salt has passed from the basin and where one-half of the added salt remains in the water in the basin. This is equivalent to the "average flowing-through period" which is the desired value.

The center of gravity of the area underneath the curve can be determined by cutting with a pair of scissors along the curve and back along the horizontal "time axis". The piece of paper so formed is then balanced on a knife edge held at right angles to the horizontal "time axis". The center of gravity is located at the balancing point at the knife edge. The time value or period represented by the point where the knife edge crosses the horizontal "time axis" of the diagram represents the flowing through time or period desired.

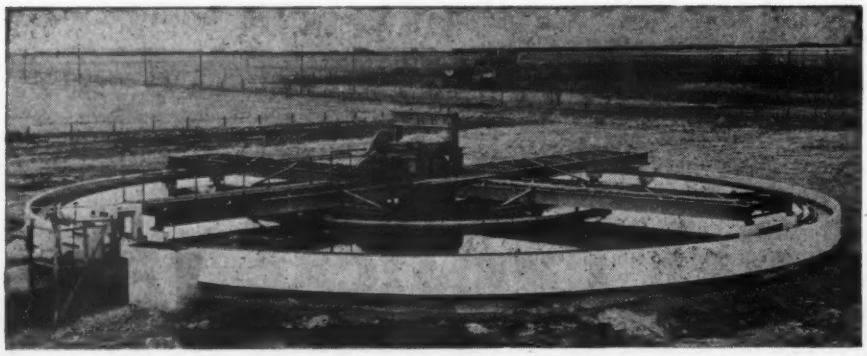
A refinement of this procedure involves the determination of the chloride content of the influent also and the plotting of the results on the same coordinate paper. In this case the area involved is that between the two curves representing respectively the values of the chloride content of the influent and effluent samples. Ordinarily, however, this refinement is not necessary, as the normal chloride content of the influent is so low that it can be considered as zero and hence as represented by the horizontal base line of the diagram.

The ratio of the flowing-through period to the computed detention period of the same basin is the measure of the efficiency of the basin. Actual tests have shown that this efficiency may be as low as 10% and as high as 50% but seldom higher. An efficiency less than about 30% indicates poor flow characteristics of the basin investigated and the need for improved inlets, baffles, etc.

Commercial Units

Space is not available for the discussion of the details of a number of commercial units developed for the flash mixing, flocculation and sedimentation of water, because most of this equipment is rather complicated and difficult to describe briefly. It is pertinent to emphasize, however, that flashmixing equipment is available for installation in those instances where the coagulant is not being quickly and effectively mixed with the raw water, and that mechanical agitators or flocculators of various types are available for use in special basins or for installations in portions of the existing structures to improve flocculation. In several instances, the flocculation and sedimentation occur in different portions of a single unit the over-all size of which is less than existing sedimentation basins which might be replaced by the new equipment. Under these circumstances improved results may be secured by replacing obsolete equipment by one of the newer units.

Descriptions of the latest developments in the types of equipment referred to in this article will be found in the Manual of Water Works Equipment and Materials, published annually by *Public Works*.



Dorrco Clariflocculator in Western Canada.

Summary

Effective pre-treatment of water consists of three steps. First, there is the selection of an appropriate coagulant and the application of an adequate dose of this coagulant to meet the prevailing quality of the water. Secondly, there is the satisfactory distribution mixing of the coagulant very quickly throughout the water, followed by effective agitation to secure flocculation of the suspended solids. Thirdly, there is the effective sedimentation of flocculated water to remove the floc without appreciable quantities of the floc reaching the filter beds. Generally speaking, i
that effective and economical operation of rapid sand filter beds is largely dependent upon the effectiveness of pre-treatment.

Meter Maintenance for Small Waterworks Departments

(Continued from page 36)

(e) Place in meter boxes the 134 meters that had not been so placed when previously set.

(f) Replace the 1,102 broken meter-box lids and locks.

(g) Place compound meters on 6 accounts where this was deemed necessary in order to get correct registration of water used.

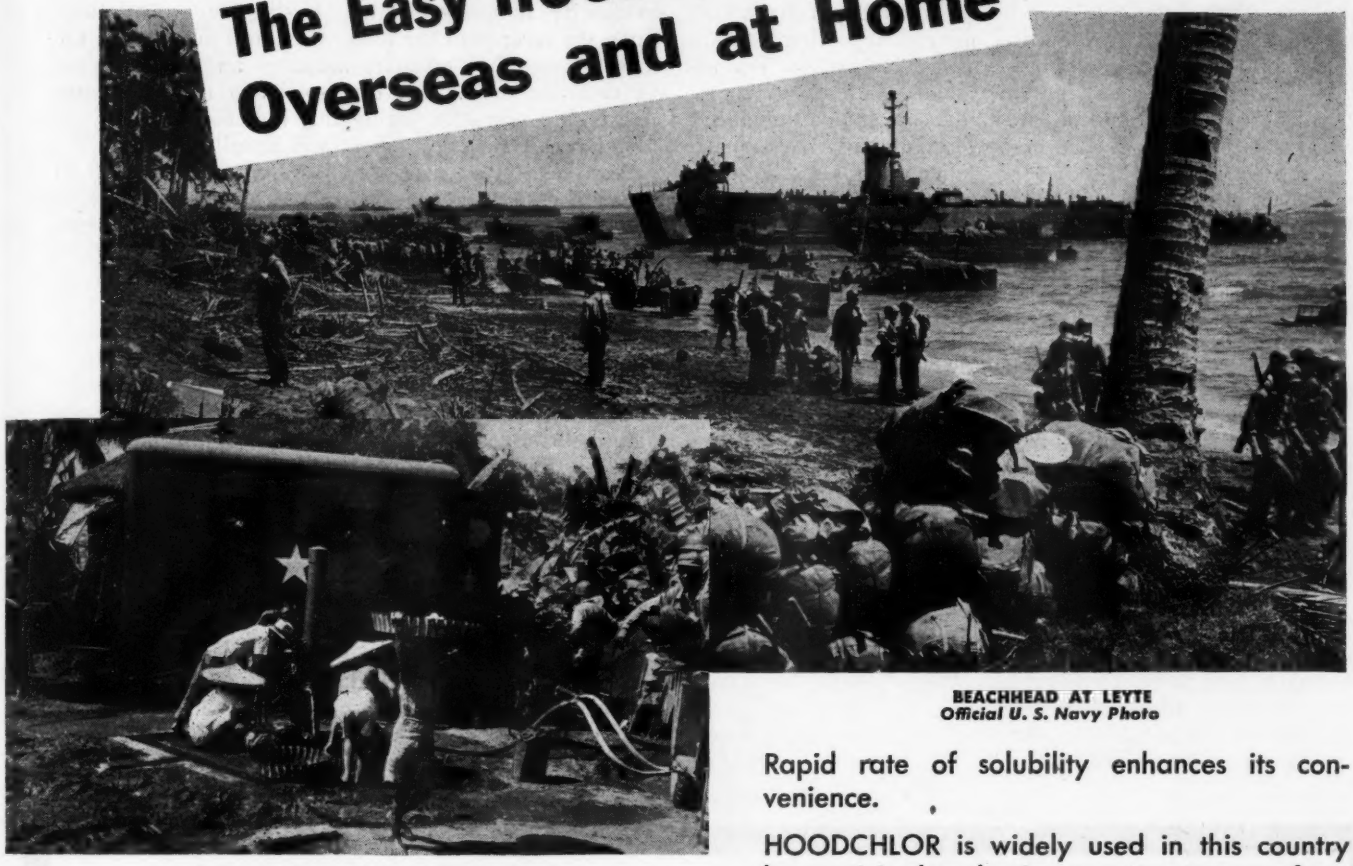
In planning this work, our intentions were to correct the worst conditions first, conserve all the time possible, coordinate our work with the main office so as to prevent erroneous billing of water accounts, and avoid other inconveniences that could be caused by removing meters for test and repair.

To carry on this work we used three men. One man was in charge of the meter shop, his principal duties being the testing and repairing of meters and keeping adequate data for permanent shop records. The other two were men who had been working in the water department for some time, were good meter readers, practical plumbers, and familiar with the meter reading routes, which made them especially fitted for this work. These men were instructed to remove meters for test and repair systematically, according to the established routes of the meter readers, securing the following information on every meter so removed:

(a) Date meter was removed.
(b) Reading of meter when removed.
(c) Make of meter.
(d) Account number.
(e) Address.
(f) Customer served.

The above information was entered on a form printed on an ordinary shipping tag 2¾ inches wide and 3¾ inches long, which was tied to each meter immediately upon removal from service. This shipping tag form called also for other data, such as test before repair, test after repair, date returned to service, new account number and new address, which information was provided by the man in charge of the meter shop, the tag being left on the meter until it was returned to service. All the information on the tag was transferred to a 6 x 4-inch card which served as a permanent record and was filed numerically according

PURE WATER— The Easy HOODCHLOR Way Overseas and at Home



BEACHHEAD AT LEYTE
Official U. S. Navy Photo

WATER POINT SET UP AT LINGAYEN, LUZON
U. S. A. Signal Corps Photo

As essential as machine guns at the fighting front pure drinking water is easy to obtain even in the most remote jungles by means of HOODCHLOR. Now used on most fighting fronts as well as by many municipal and private water works throughout the United States.

HOODCHLOR

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HIGH TEST HYPOCHLORITE

When HOODCHLOR is fed into the drinking water supply it quickly destroys and prevents growth of dangerous bacteria. This high test calcium hypochlorite in free-flowing granular form retains its strength for a year or more. Rapid rate of solubility enhances its convenience.

HOODCHLOR is widely used in this country by municipal and private water systems of not over 500,000 gallons daily capacity and by larger works for emergency use. It destroys slime and algae in reservoirs, tanks and mains.

HOODCHLOR is also extensively used in sewage treatment, and for sterilizing swimming pools. Many municipalities keep a supply on hand for emergency use when fires, explosions, floods, or other disasters disrupt the regular supply.

HOODCHLOR is now shipped in convenient resealable steel pails, lined with chlorine resistant lacquer. Net weight 25 pounds. Also packed in 3¾ lb. cans, 12 to the case; and 5 lb. cans, 9 to the case.

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CAUSTIC SODA · BICARBONATE OF SODA · SODA ASH · CHLORIDE OF LIME

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to account number. This method has proved very satisfactory and prevented any erroneous billing of water accounts due to the removal of meters for test and repair.

The three men who carried out this program had previously been employed by the water department for making water taps, setting meters, repairing leaks, reading meters, and other duties necessary for maintaining a water distribution system. These duties they continued to perform, with the meter maintenance work in addition. The man who had been trained at Austin was put in charge of the meter repair shop. He could test and repair only about 6 meters a day, and as the other two men could remove and set approximately 15 meters a day, this left about two-thirds of their time available for performing their former duties, working overtime when necessary. Monthly meter reading, however, required the time of two men for six days, which necessitated closing the meter shop while the reading was done by the meter repair man and one of the field men. If the second field man, in performing the general maintenance work, needed help at this time, it was provided from the street maintenance crew. In this way we kept the meter shop in operation 19 or 20 days each month, without employing extra help, the only additional labor expense incurred in carrying out this program being approximately $400 for overtime.

When the meters had all been put in good condition it did not require all the repair man's time in the meter shop, and to utilize his spare time profitably we have given him added duties in the water department with which he was familiar and which did not conflict with his meter shop work.

The Proof of the Pudding

It has now been practically twelve months since we completed this program, which has given ample time for learning the results obtained—whether we had increased the revenue of the water department enough to justify the expenditures. Basing our calculations upon the records of the meter shop and main office, the most conservative estimate indicates an 18% increase in revenue, or $7,150, due solely to meter maintenance. The cost of securing this increase was:

Meter repair shop equipment and installation cost	$ 825.00
Meter parts	1,191.35
New meters	1,325.00
New meter boxes	390.00
Meter box rings and lids	576.25
Meter box rings and locks	1,223.30
Overtime labor	400.00
Total	$5,930.90

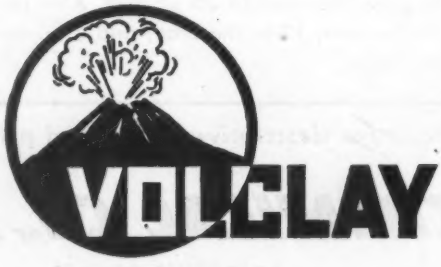
This cost is less than the increase in revenue for one year only. But this is by no means the whole story. We are able to make a reasonably close estimate of what our future meter maintenance costs will be. With our meters now all in good condition, we are convinced that $50 per month will cover all expense necessary to keep them so; a good portion of the meter repair man's time being utilized in other duties connected with the department. Deducting this $600 a year from the $7,150 gain in revenue, we have a net profit of $6,550 annually, which we can continue so long in the future as we maintain our meters properly.

It is my conviction that any water works with 1,800 meters can well afford to provide a means of meter

Slow but sure. Processes and chemicals used in clarification of industrial liquors are entrenched by long established successful usage. Colloidal bentonite is so radically different that changing to its use is a gradual development. But its employment in many more clarification problems will be inevitable when its unique activities become better understood.

The main duty of a coagulant is to entrain impurities within its flocs. Colloidal bentonite does that, but in addition has properties not possessed by other coagulants. Absorption of certain organics, removal of color and reduction of odors are some of its characteristic functions.

And, it is effective over a wider pH range than others.



VOLCLAY is first among bentonites for floc-forming and absorption qualities. Produced in powder form and also as the well-known KWK VOLCLAY grade which can be dispersed in water much more conveniently than powder.

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I mean our town's new kind of water!"

Sure he loves it! So will everybody in *your* city. Because *this* kind of water—conditioned by Permutit*—makes any city a better place to live, work and play!

Permutit removes hardness and other impurities from municipal water supplies, makes the water soft, clear, free of iron.

Plan *now* for this Number One Improvement in your city. Write to The Permutit Co., Dept. G-4, 330 West 42nd Street, New York 18, N. Y. or Permutit Co. of Canada, Ltd., Montreal.

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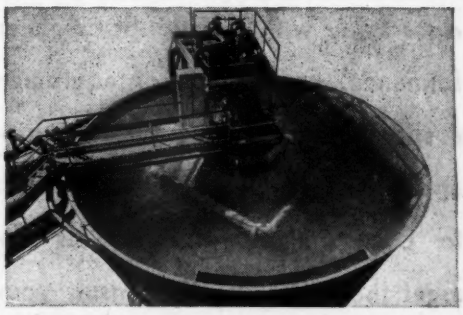
WATER CONDITIONING HEADQUARTERS



PERMUTIT SPAULDING PRECIPITATOR removes hardness, dirt and color by the sludge blanket process. Cuts detention time, saves chemicals and space. Present installations handle capacities up to 120,000,000 gallons daily. One of many Permutit methods of treating water.

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It's a step in the right direction when you standardize on Mueller Water Works Equipment and Supplies because the use of Mueller Products does away with any doubt or uncertainty of performance. Each piece of equipment is built for a specific job for the varied types of operating and maintenance conditions. There is no need to compromise with materials that "half-way" meet the job at hand. Consult your red Mueller Catalog "H" or write us about your requirements.

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When writing, we will appreciate your mentioning PUBLIC WORKS

maintenance; and when there are schools provided for training meter repair men, the smaller water works will be more inclined to install meter repair shops and adopt efficient methods of operation. I fully realize that one of the most difficult problems encountered by superintendents of the small water works, when considering meter maintenance, is securing efficient help, and the Texas Water and Sanitation Research Foundation of Austin, Texas, is to be commended for their efforts in this direction.

HIGH CHLORINE DEMAND AT WATERFORD, N. Y.

By R. G. YAXLEY
Superintendent of Water, Waterford, N. Y.

TWO subjects should be kept constantly in mind by waterworks officials: First, that the distribution system is a part of the waterworks for which they are responsible and that sterile water should come out of the consumers' service pipes as well as from the pumping station. Second, that a "positive" lactose tube should mean something more than a source of annoyance to the laboratory worker, requiring him to proceed through further steps to prove to *his* satisfaction that there was nothing in the sample in the first place and that differentiating between aerogenes and coli is something about which leading public health departments are not too enthusiastic. The above is an introduction to a brief review of some work done in a small water plant situated in the eastern part of New York State.

Waterford, N. Y., a town of about 6,000 population, obtains its supply from the Hudson river, a stream fairly typical of that section of the country. Color, M.O. alkalinity and hardness will each average less than 40 ppm. Ponds and marshes in the upper waters supply the resultant of decayed vegetation, and industrial wastes from sulphite pulp plants and paper mills do not improve coagulation in a rapid sand filter plant. In spite of a minimum flow of over 2,000 cfs, a watershed population of at least 150,000 insures a heavy bacteria load, coli being present at 1/100 cc of raw water most of the time.

Over ten years ago pre-chlorination was started, and since that time there has been no difficulty in producing a sterile plant effluent. But (and that is a most annoying word) during warm weather, as the water temperature increased above 60 degrees, agar counts in system samples would increase and lactose positives appear. As the August days arrived they brought aerogenes and all too frequent confirmed coli.

Two points should be borne in mind: the plant operates about six hours per day and the high pressure pumps discharge into the distribution system, the excess going into steel storage on the farther side of town. It was felt that if a chlorine excess could be maintained in the system at all times, the after growths could be controlled. The theory is correct but the solution difficult.

Let us digress a moment and ask what is the "chlorine demand" of a given water. Some use a 10-minute period; using that as a standard, a series of tests which we ran last summer indicated that our raw water demand was about 2½ ppm, yet a series of quart samples in glass stoppered bottles held in darkness for 30 hours showed only a trace of residual with a dose of 16 ppm and only 10 ppm with a 100 ppm dose. Was the actual demand at that time 2½, 16 or 90? This question of long-time demand assumes importance

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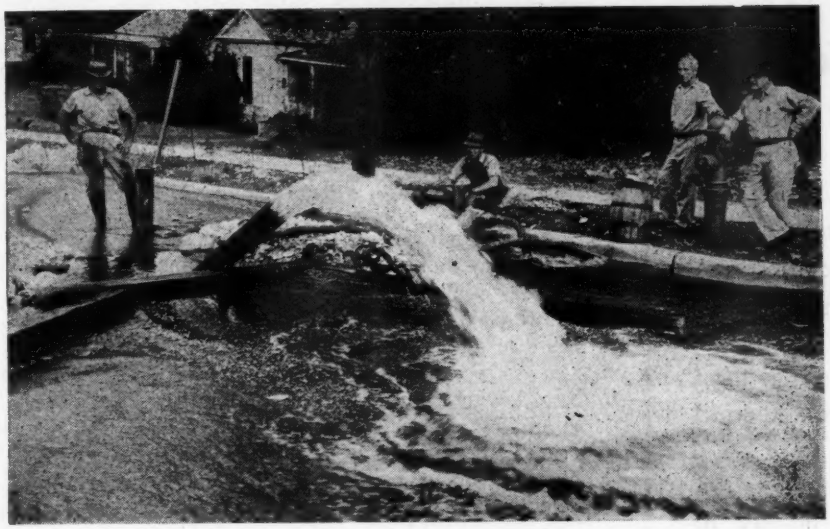

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The *one* place you want experienced service is in your water main cleaning. Too much depends upon your uninterrupted water supply to justify taking chances. 38 years of successful cleaning experience are at your command when you employ National to do this important work. All the improved technique that comes from being America's leading water main cleaners for over a third of a century is at your disposal.

WHY CLEANING IS NEEDED

Mains down over 20 years easily can lose 50% of original capacity through encrustations and foreign matters, which reduce pressure, quantity and quality of water, as well as increasing pumping costs and keeping insurance rates up. Such mains can be cleaned the National way in from 5 to 7 hours, at night if necessary. Service can be resumed very quickly in any emergency.

WHAT YOU GAIN FROM MAIN-CLEANING BY

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1.—More water

2.—Better water

3.—Higher pressures

4.—Lower pumping costs

5.—Lower fire insurance rates

6.—Satisfied consumers

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Our experts can make valuable suggestions about the best, quickest, and most economical ways to restore 95% of your pipe's original capacity. This is without any obligation on your part, and can prove one of the most satisfying discussions you have ever had on obtaining improved water main efficiency.

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PITOMETER SURVEYS

Save Costly Expansions of Water Works

By finding and eliminating water leaks. The cities named below are meeting current war demands by full use of existing facilities first, as a result of PITOMETER surveys.

They realize that this is sounder practice than costly expansions which will not be needed when normal times return.

They realize, too, that it costs money to produce waste water. So they have employed the services of this engineering organization to make PITOMETER water waste surveys.

FAR SIGHTED COMMUNITIES

PHILADELPHIA	CINCINNATI
PITTSBURGH	ROCHESTER
BOSTON	McKEESPORT, PA.
WASHINGTON, D. C.	HUNTSVILLE, ALA.

BILOXI, MISS.

and many smaller ones as well.

A PITOMETER SURVEY INCLUDES

1. Tests of pump efficiency.
2. Measurement of total consumption.
3. Test of master meters for accuracy.
4. District measurement of consumption.
5. Further investigations in districts where waste is indicated, which result in the location of all underground leaks of the mains and services.
6. Check-up of larger users to detect unauthorized use.
7. Revenue increases through large-meter accuracy tests.
8. Report on all valves, with map and record checks.
9. Report on all details, with recommendations for improvements.

Also ask for information on our two other services, "Water Distribution Studies" and "Trunk Main Surveys."

THE PITOMETER COMPANY

Water Distribution Engineers

48 CHURCH STREET NEW YORK, N. Y.

When writing, we will appreciate your mentioning PUBLIC WORKS

when one considers that it may require several days for the water to reach some consumers.

During the winter months we apply the pre-chlorine to the outlet of the sedimentation basins in sufficient quantity to maintain a system excess. This is not difficult with ice water, although a light post-chlorine dose is sometimes required for a couple of hours after starting, until the water that has stood in the filters and clear well over night has passed on. This method is entirely satisfactory and saves money as the pre-chlorine dose is only 2½ to 3 ppm. However, as soon as water temperatures reach about 45 degrees the pre-chlorine point of application is changed to the incoming raw water and the rate raised above break-point, which runs from 7 in the spring to 9 in mid-summer. Incidentally, tests have shown three distinct break-points—9, 18 and 27 ppm, and there must be more or there would have been more than 10 ppm excess left after a 100 ppm dose as mentioned. For the last three weeks of August, 1944, with a reasonably good water, our average pre-chlorine dose was 12.70 ppm, maximum 13.61, minimum 10.84. At the same time an average post-chlorine dose of 2.44 ppm was used. Hourly residual readings were taken of plant effluent and the lowest recorded reading was 1.75 ppm. There were 14 days when residuals leaving the plant were above 4.00 ppm and 6 days when it reached 6.00 ppm. Samples are taken from the distribution system each morning before the plant starts and, in spite of the high residuals present only a few hours before, there were 9 mornings when no residual was present and only a trace on the other 12. These high residuals may be considered impossible by some but nevertheless are true. At no time would there be any taste or odor of chlorine in either hot or cold samples and we have a large industrial plant and domestic consumers taking service within 300 ft. of our plant without complaint.

As a result of this drastic treatment, gas formers in the distribution system have become rare, last season not a single presumptive in lactose, while coli and its doubtful cousin aerogenes, were extinct. This type of treatment has its drawbacks and should not be attempted without careful preliminary tests. Operating costs are high, 15 ppm of chlorine cost money, and close attention is required, especially with a surface water subject to frequent changes. Floc formation in basins and color reduction is not so good, but if one feels that the consumer on the other side of town should have good water as well as one close to the plant, this is one way of meeting the problem; also one can meet that new U. S. Treasury standard that seems to give some of the brethren considerable trouble.

How Normal Collects Delinquent Water Bills

L. B. Pepple, superintendent of the Water Department of Normal, Ill., informs us that the method of collecting delinquent bills employed by his department is 100% effective and involves very little trouble.

The meter records are kept in 8 books. Meters in books 1 and 2 are read during the month of April; those in books 3, 4 and 5 during May, and those in 6, 7 and 8 in June. Bills are sent out the 1st of the month following that in which they were read. If they are paid before the 20th of that month, a 10% discount is allowed. If they have not been paid by the 10th of the following month, a red "past due" card is sent; and if not paid by the 20th of that month, the water is turned off and not turned on again until the bill has been paid.

Pumping of Concrete Pavements, and Remedies Tried

Experiences with soil-cement mudjacked under, load-transfer devices, oil asphalt forced under, and other measures.

FIVE papers discussing pumping of concrete pavements were prepared for the 24th annual meeting of the Highway Research Board (which was cancelled) by Rex M. Whiting, William Van Breemen, H. L. Krauser, C. W. Allen, Harry E. Marshall, and R. E. Frost.

The first described experience in Missouri with the use of a semi-fluid soil-cement mixture forced under the slab with a mudjack, using 4 sacks of cement per cu. yd. of top soil and 50 to 55% of water. Averages of 354 holes per mile and 0.5 cu. yd. of slurry per hole were used. It was noted that, under moving leads, deflections increased immediately after filling the voids and then decreased. A few of the slabs resumed pumping after the mudjacking.

Mr. Breemen, discussing experiences in New Jersey, said that:

"Pumping at joints in concrete pavement slabs was first observed in New Jersey in 1930. It occurred on all pavement of standard design in which dowels ¾-in. in diameter were used for load transfer. A 100 per cent increase in the number of dowels did not eliminate the trouble. The use of crushed stone drains along the edge of the pavement was only partially effective in stopping pumping.

"In 1932 a test road was built over a silty-clay soil. One joint with no load transfer device, two with six ¾-in. round dowels in the 10-foot width of pavement, two with twelve ¾-in. dowels, and several with various combinations of heavy rectangular and channel type dowels were placed in the slab. Continuous applications of heavy loads under adverse moisture conditions indicated that the use of a load transfer device composed of 2-in. channel-dowels was necessary to prevent faulting and subsequent pumping.

"A recent survey of 60,000 channel-dowel joints on heavy duty highways disclosed only three failures that were caused by pumping. No faulting was found at these joints and the failures had occurred by sagging of the pavement. The stone drains along the edge of the pavement were partially clogged with subgrade soil.

"A study of pavements laid on sub-bases composed of granular materials leads to the conclusion that their use minimized pumping, reduced damage due to frost action and increased load-bearing capacity. All pavements built since 1939 are supported on a layer of bank-run sand, gravel or cinders 8 inches in thickness. To date, where granular materials have been used in conjunction with channel-dowel joints, pavements have remained true to grade, cracks are few and far between, and there have been no indications of pumping, even under heavy truck traffic."

In Ohio, pumping was found to be much more extensive and severe over areas where no granular material was used under the pavement. On plain concrete, pumping was more severe at contraction joints of the premolded type than at expansion joints. The severity on a reinforced section was about the same for expansion and contraction joints. On plain concrete slabs without granular sub-base, 2% of the expansion joints and 52% of the contraction joints were pumping, but on those placed on a granular sub-base, pumping occurred at 1.5% of the expansion and 16% of the contraction joints. On a reinforced section, 71% of expansion joints and 91% of the contraction joints were pumping.

A survey of Ohio's concrete pavements indicated that pumping has occurred mostly, but not exclusively, on soils of the A-4, A-6 and A-7 groups. The moisture content of the subgrade was found to be a maximum immediately beneath the pavement, indicating that surface water is the chief source of the subgrade moisture that causes pumping. Transfer devices at joints and granular subgrades have been found the most effective preventives. French drains in the shoulder were not effective.

After experimenting with various soil-bituminous, portland cement mixtures and several grades of semi-solid asphalt, an oil asphalt filler having a penetration of 30 to 45 at 77°F was found most satisfactory for filling voids under pumping concrete slabs, this material being forced under the pavement by means of the hand spray equipment of a standard bituminous distributor through holes drilled through the pavement. The bituminous material forms a tight seal be-

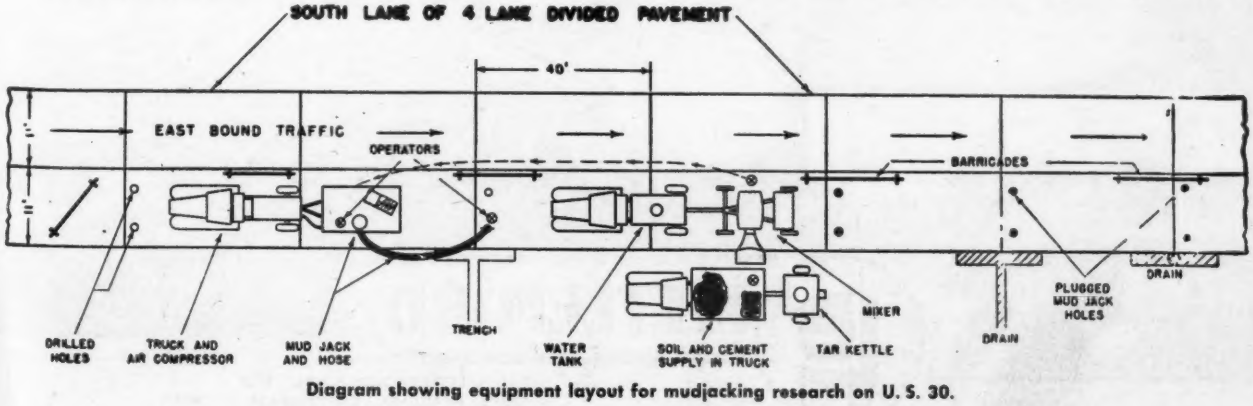


Diagram showing equipment layout for mudjacking research on U. S. 30.

neath the pavement and prevents the entrance of surface water, and its stability is not affected by moisture from the subgrade.

Experiments in mudjacking were conducted on a two-mile section of road in Indiana, using four mixes:

Mix A; 77% soil, 7% RC-3, 16% cement
Mix B; 77% soil, 7% Road Oil, 16% cement
Mix C; 77% soil, 7% Tar, 16% cement
Mix D; 79% soil, 3½% Tar, 17½% cement

An average of 8.7 cu. ft. was placed in each of 50 joints. Inspection two years later showed somewhat less settlement at the treated than at the untreated joints. Also the number of cracks was less in this section of road than would normally occur. Of the four mixes, the slabs in which A and D were used contained less cracks and less settlement.

Airport Revenues

"The important part that terminal services and the little miscellaneous items can play in financing an airport is admirably illustrated in the 1944 fiscal year statement of the Washington National Airport. Out of a gross income of $516,470, the airport took $90,968 from the sales of food, tobacco, newspapers, locker space, paper cups, conducted tours, napkin dispensers and other odd items. Sales of food in the restaurant, coffee shop, hangar cafe, public roads and employees' cafeteria, and in the form of box lunches and meals aloft brought in $79,632. Other revenue items in general classifications during the 1944 fiscal year were rentals, $120,116; landing fees, $30,675; ramp service, $17,042; charter and sightseeing service, $2,000; gasoline concession, $150,000; taxicab and bus concessions, $15,850; sale of utilities, $75,458.

Timber Cribbing at a Highway Washout

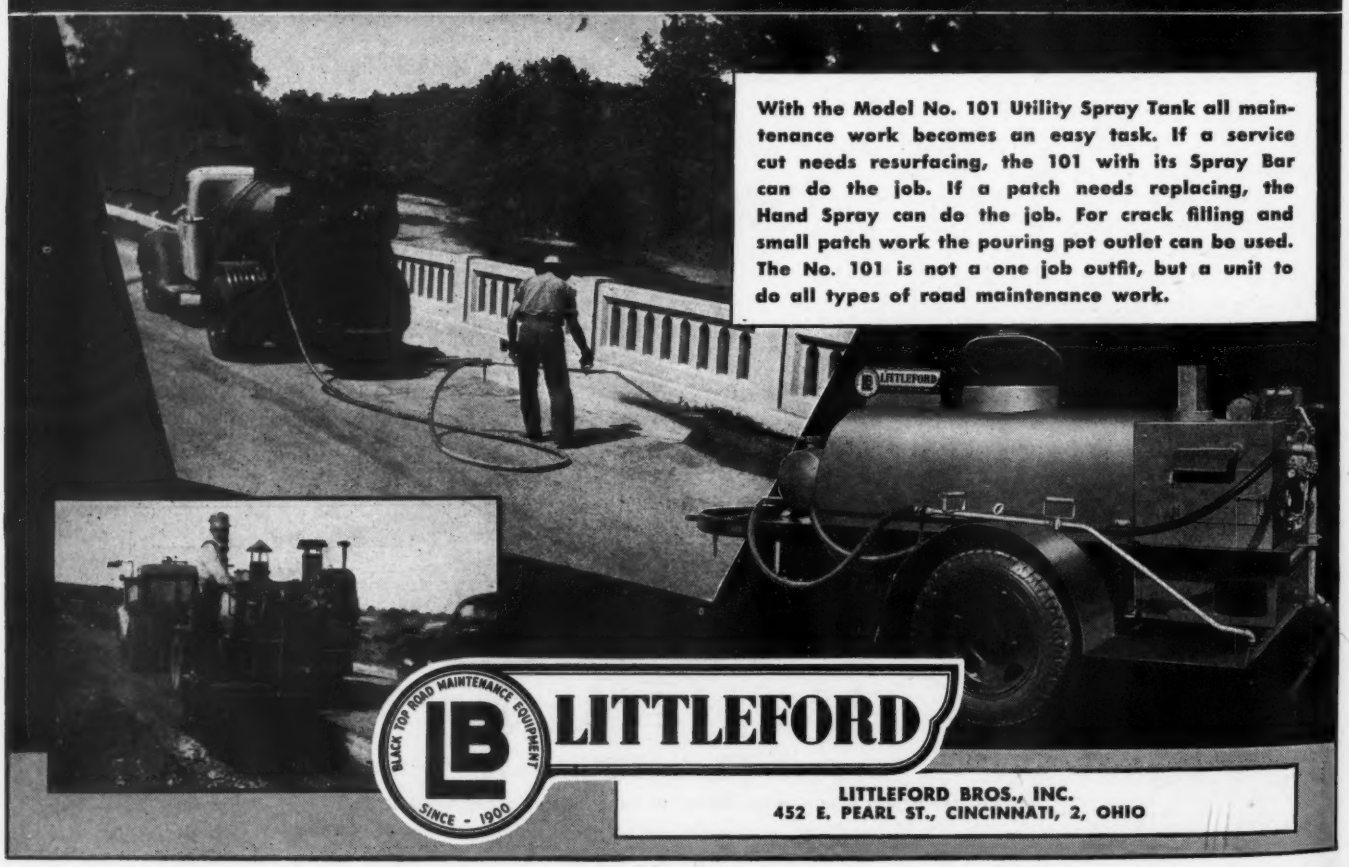
By A. J. KEATING
Superintendent of Highways, Essex County, New York

A PART of a road along the Boquet river, in Essex County New York, was on a fill about 10 ft. deep placed on an unstable stratum of clay. During the early summer of 1944 numerous heavy rains saturated the area adjacent to this, and a slight settlement of the roadbed was observed. Several weeks later the river rose to flood proportions and the entire section of roadway, including several large trees, sild toward the river for a distance of 30 or more feet, and the flood waters carried away a large quantity of the slide. The highway had to be closed to all traffic until repairs could be made, and these could not be started until the flood receded.

Beginning the construction of the cribbing.

THIS UNIT DOES MORE THAN ONE JOB!

With the Model No. 101 Utility Spray Tank all maintenance work becomes an easy task. If a service cut needs resurfacing, the 101 with its Spray Bar can do the job. If a patch needs replacing, the Hand Spray can do the job. For crack filling and small patch work the pouring pot outlet can be used. The No. 101 is not a one job outfit, but a unit to do all types of road maintenance work.



BLACK TOP ROAD MAINTENANCE EQUIPMENT
LB
SINCE - 1900
LITTLEFORD

LITTLEFORD BROS., INC.
452 E. PEARL ST., CINCINNATI, 2, OHIO

A NEW STANDARD FOR HEAVY-DUTY TRUCKS

The Army called for the roughest, toughest truck that could be built, designed to *begin* its job where most other trucks stop.

Ward LaFrance has been producing this super truck in volume for Army ordnance. Out of it has come an entirely new standard of heavy-duty truck reliability and performance. Ward LaFrance has been building good trucks for a quarter of a century, but frankly, never any that could compare with these new commercial models inspired by the design and performance of the Army M1A1 Heavy Wrecker. They are *big* trucks with pay load capacity ranging up to thirty tons. They are built to take a beating and still stay on the job. They are designed, engineered, and manufactured to establish new standards in low-cost hauling. Before you invest, investigate Ward LaFrance.

FRANCHISES ARE AVAILABLE to aggressive dealers in a number of attractive territories. Leading dealers now handling smaller, non-competitive trucks will be especially interested in the Ward LaFrance dealer plan.

WARD LAFRANCE

TRUCK DIVISION

GREAT AMERICAN INDUSTRIES, INC.

ELMIRA, NEW YORK

HOW FLINK *Self-Feeding* SPREADER DOES SEAL COATING BETTER

Spread an even layer of material, thick or thin—as desired, as the truck is backed up . . . thus avoiding damage to tires or leaving tracks of oil. Spreads full width of street. Does it faster, smoother with less help.

Flink self-feeding material spreaders save time, materials and reduce accidents. They have been proved in tough road construction and maintenance jobs all over the country.

Faster. Operated by driver from cab who can throw spreader in and out of action as he approaches or leaves area to be spread.

No helper. Raising the dump truck causes load to fall towards spreader. This plus positive agitation eliminates man on back.

Fits all dump trucks. The Flink spreader is a replacement end gate, it is not a body, a trailer or a "gadget."

Does not limit use of truck. Dumps same as with regular end gate, or replace original end gate in 5 minutes. Continue to use truck for all other purposes.

Efficient use of materials. Spreads thick or thin, evenly . . . without barespots as with hand or revolving disk methods. Spreads all materials up to 1". Write for complete information.

Flink Spreaders are ideal for all types of road and street spreading, for ice and dust control, for spreading agricultural limestone.

The FLINK COMPANY

506 VERMILION, STREATOR, ILLINOIS

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The construction of the vrib further advanced.

As soon as possible a temporary roadway was built from the highway to the bottom of the slide. Hemlock logs were purchased on the stump, cut to 12 ft. lengths and 12" to 24" diameter, and hauled four miles to the site of the slide, to be used in making a crib. To receive this, an excavation was made 12 ft. wide, 130 ft. long and to a depth 2½ ft. below the river bed, the excavated material being cast along the edge of the river to keep out the water. In this the 12 ft. logs were laid parallel to the road and cross-ties spiked at 8 ft. intervals using 18" wharf spikes. As each course of crib work was completed it was filled with field stone. Eight courses were placed in this manner, and the excavated material was cast back against the face of the crib and the fill completed from the crib to the roadbed, 18 ft. above the bottom of the crib. Approximately 580 cu. yd. of field stone was used in the crib; about 2,500 cu. yd. of material was excavated and 1,500 cu. yd. was back-filled. The project cost approximately $4,000.

Special Benefits Deductible From Money Compensation

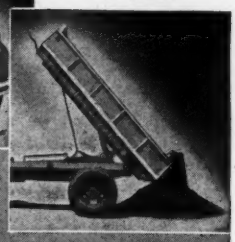
The Missouri courts hold that, in condemnation proceedings, special benefits to the property may be considered in determining the compensation to be paid. After deducting the benefits, the amount of compensation due is the difference, and if the special benefits equal or exceed the damages, there is no money compensation due. State ex rel. State Highway Commission (Mo. App.) 110 S. W. 2nd. 883.

GAR WOOD TRUCK EQUIPMENT

FOR YOUR SPECIALIZED JOB

GAR WOOD INDUSTRIES, INC. GW TRADE MARK

Cam and Roller Hoist for long wheelbase chassis. High ground clearance for piling.



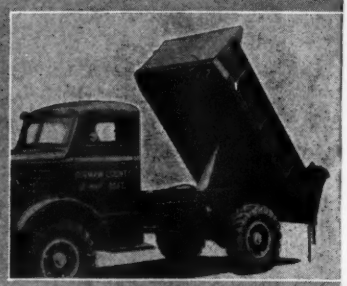
Direct-Lift Hoist. Body has trussed understructure, an exclusive feature.

Hydraulic and Mechanical Hoists, Dump Bodies, Winches, Cranes and Tanks, Including Flushers and Sprinklers for Trucks and Trailers

The units described on this page will give you an idea of the diversified line built by Gar Wood. Get your job done efficiently by selecting the equipment designed to fit your particular needs. Remember that Gar Wood is the world's largest manufacturer of truck and trailer equipment, and years of experience back up each unit. Be sure of dependable, top-notch performance . . . specify GAR WOOD.

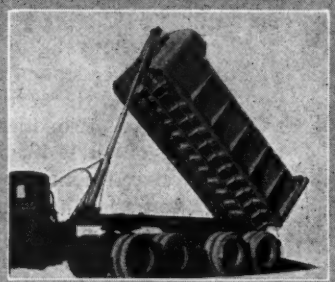
Support the 7th War Loan Drive BUY MORE BONDS

Typical Installation for Six-wheelers.

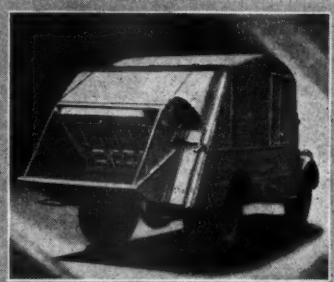


Telescopic Hoist. Heavy-Duty Body.

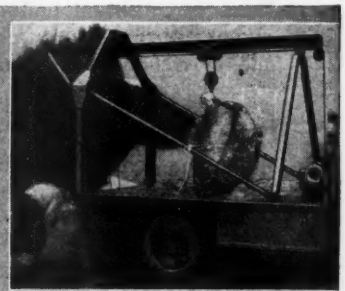
Dual Telescopic Hoist and Rock Body. Down-folding gate.



Vertical Telescopic Hoist for long bodies.



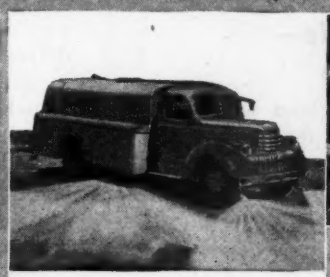
Load-Packer. Compresses garbage and rubbish. Greater loads—fewer trucks and men required.



Tree-Moving Crane picks up, transports and re-sets trees.

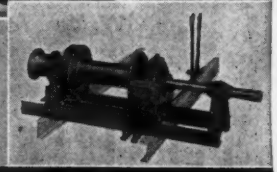
Hydraulic Repair Tower.

Tanks for all types of liquids.



Street Flushers and Sprinklers.

Cranes. All types and sizes for handling pipes, machinery, etc.



Utility Winches in both single or double drum types.

Branches and Distributors in All Principal Cities

GAR WOOD INDUSTRIES, INC.

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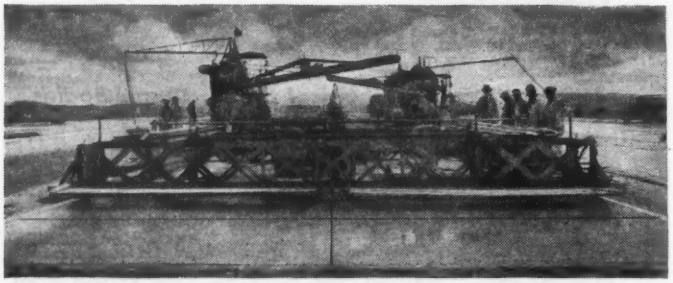
World's Largest Manufacturers of Truck and Trailer Equipment

HOISTS AND BODIES • WINCHES AND CRANES • TANKS • ROAD MACHINERY • HEATING EQUIPMENT • MOTOR BOATS

When you need special information—consult the classified READER'S SERVICE DEPT., *pages 97-99*

Here's Why Road Men Prefer 'FLEX-PLANE' Dummy Joints



Good Timing

With a high speed 'FLEX-PLANE' joint installing machine dummy joints are put in at 'just the right time'—every time—for best results . . . no waiting . . . no delays.

Uniformity

There is consistent uniformity of joints . . . good alignment and same depth whether you install one or a hundred joints.

Always Ready

When the concrete is ready, the machine is ready . . . this relieves the contractor of constant supervision.

Speeds the Job

'FLEX-PLANE' joint installers permit close spacing of transverse joints—it never gets behind.

Better Joints—Better Roads—Seldom any Maintenance

Low spots along the joints are eliminated when a 'FLEX-PLANE' machine is used to cut the groove—thus eliminating filling in with excess matrix or dry materials.

Write for details on the 'FLEX-PLANE' Joint Installer.

FLEXIBLE ROAD JOINT MACHINE CO.

WARREN, OHIO

When writing, we will appreciate your mentioning **PUBLIC WORKS**

Wartime Construction of a Concrete Bridge

Details of Construction Methods and Equipment Used

By R. D. HORNEY
County Surveyor, Hamilton Co., Indiana

THE flood of May 19, 1943, destroyed a bridge known as "Flowing Well" bridge because about 100 ft. away is a well from which a 3" stream flows at all times about 14 ft. above low-water elevation. This bridge had a single span of 50 ft. with a 14 ft. wood floor roadway, the end posts being set on sills approximately 2 ft. above water level. It was constructed approximately 50 years ago.

Plans and specifications for a new bridge were prepared by revamping plans already on file in the office, following very closely those of the Indiana State Highway Dept. They provided for two 35 ft. spans, with a 20 ft. roadway and 15-ton H loading. The two outside beams and the center one were originally designed to be 21" W. F. 103#, but these were not obtainable and 21 W. F. 112# beams were substituted. Between these were four 21" W. F. 68# beams.

The abutments and center pier were of concrete with extra wide footings on a sand and gravel foundation 8 ft. below the bed of the stream. On account of priorities, not much steel was used in the substructure; a few bars were placed in the pier and in the abutment wings. Three 10" channel 15.3# diaphragms were placed between each set of beams in each span. The pier was made 3" higher than the abutments to provide the camber, and the roadway crown was taken care of by using different thicknesses of plates under the beams.

The contractor was to furnish all labor, equipment and material, except that the county furnished the sand and gravel delivered on the job.

This job and two others were advertised and bids opened July 26th 1943, but there was only one bidder for this job and none for the others. He was given the contract, but as he had another job to finish he did not get started on this one until about Nov. 1. The weather after that was not very severe and he continued working most of the winter. The bridge was opened for traffic May 29, 1944.

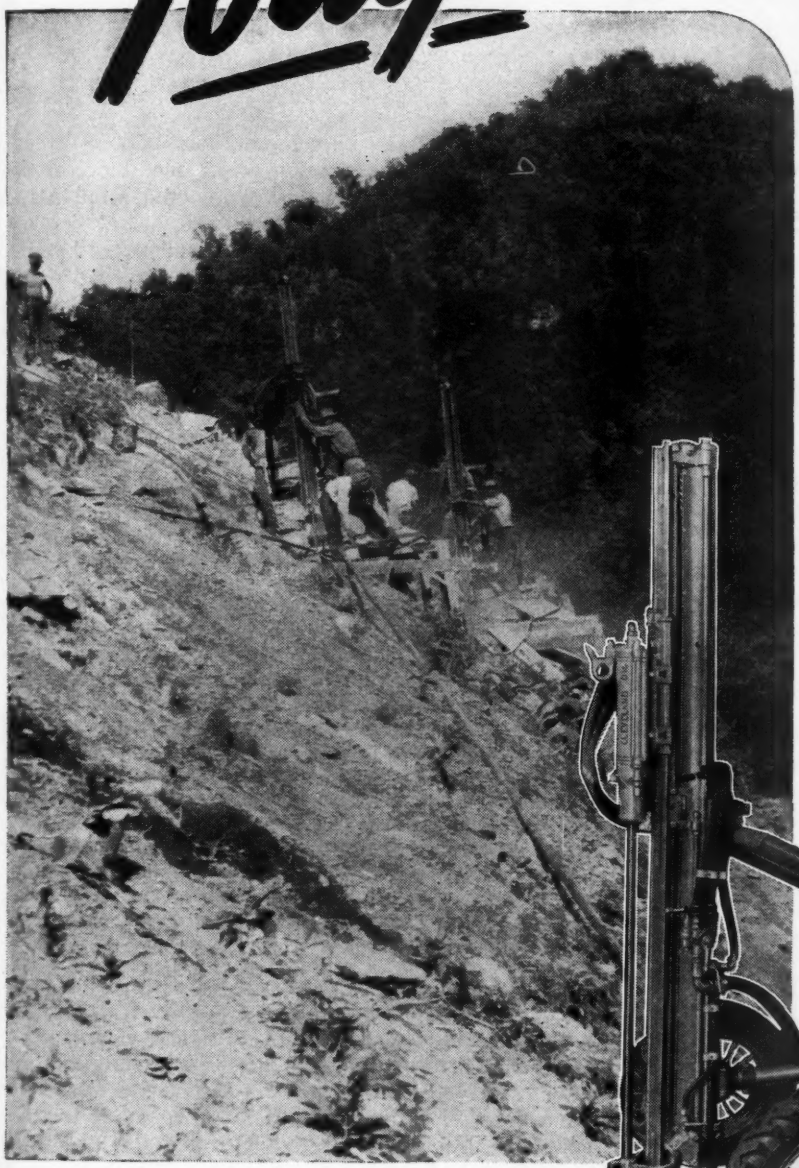
A coffer dam was built around the pier site, using 6 x 8 hard wood timbers and 2" sheeting. Excavating was done with a clamshell bucket. The sheeting was driven with a light-weight drop hammer. The water in the cofferdam was kept down by means of a Gorman-Rupp 6" pump; the cofferdam having been made 2 ft. larger than the footing so that the space between it and forms for the footing provided a sump for the pump. At no time was concrete placed in water. During the pumping it was noticed that the flow of water from the well 100 ft. away decreased considerably.

After the footing had been poured, all braces were removed, the sheeting being tied back with cables, and the pier forms were built complete. All forms were faced with ⅜" ply wood, giving a smooth surface to the concrete and reducing considerably the amount of rubbing required. The pier was poured in one continuous operation. When the concrete had set it was rubbed above the water line.

The same procedure was followed in building both

Tough Terrain!

But NOT too tough for CLEVELAND Wagon Drills!



● The mountain side is so steep on this road-building job that the wagon drills must be held with ropes. Yet even under such difficult conditions the Cleveland DR30 proves its mettle.

As this picture indicates, the DR30 is unsurpassed in maneuverability. The machine drills at *any* angle and in *any* direction—flat holes from 4" to 8' above ground—also straight up or down. Feed travel is over 8', permitting 6-foot steel changes, and the machine handles depths to 25' or more. The DR30 has a double screw U-bar jack, a recoil device to increase cutting speed, an improved centralizer, and a forward leg point to steady the drill. All these features make the Cleveland DR30 the most popular wagon drill ever built.

ASK FOR BULLETIN 132

Pneumatic tires now obtainable if specified by purchaser in his application for priority to Construction Machinery Branch of War Production Board.

SPEED FINAL VICTORY!
BUY MORE WAR BONDS

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DIVISION OF THE CLEVELAND PNEUMATIC TOOL COMPANY
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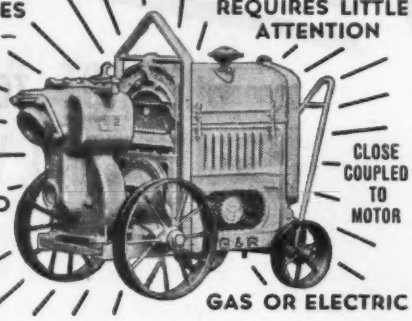
Streamlined Inside
for Higher Efficiency and Lower Operating Costs

RUGGED SIMPLICITY OF DESIGN ELIMINATES RECIRCULATION –
NEVER LOSES PRIME REQUIRES LITTLE ATTENTION
DELIVERS GREATER VOLUME PER GAL. OF GAS
NO ORIFICE OR PRIMING VALVES TO CLOG OR JAM
CLOSE COUPLED TO MOTOR
CAPACITIES UP TO 125,000 GPH
GAS OR ELECTRIC



Streamlined where it counts, you can't clog a Gorman-Rupp Self-Priming Pump. Unequaled in rugged efficiency, gallonage or continuous hours. A size and type for every need.

THE GORMAN-RUPP COMPANY, MANSFIELD, O
GORMAN-RUPP
SELF-PRIMING CENTRIFUGAL PUMPS

CONSERVATION PLUS

Today when steel and men hours are so vitally important, the advantages found in the use of CAINE Corrugated Steel Sheet Piling are more important than ever. Whether in construction of airports, plants or other defense work, or in civilian construction products, CAINE Corrugated does its share in conservation—plus.

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abutments, the lumber from the pier cofferdam and forms being used with some additions.

The beams were welded together over the pier and all joints between beams were welded. No dowel bolts were used. An interesting feature of the welding together of the beams was the effect of the contraction of the weld, which caused one end of the beam to rise from its abutment as much as ¾ inch.

The depth of the floor beams used necessitated raising the bridge floor undesirably high above the adjacent ground, which was quite low, and causing a hump in the road. In order to minimize this hump, the 6¼″ concrete floor slab was lowered 4″ between the beams, leaving only 2¼″ above their top surfaces. The slab was reinforced at top and bottom with 1½″ square bars spaced 6″ apart laterally and 2″ longitudinally.

The handrail was concrete with base and cap poured continuously, with expansion joints over the pier and two more in each span. Bush-hammered blind panels were formed on each side of the rail.

All excavation and concrete materials were handled by crane. The force on the job never exceeded 4 or 5 men, except that 2 or 3 were added during concreting. The following equipment was used on the job:

⅜-yard Bucyrus-Erie crane,
Allis Chalmers bulldozer,
7-S Jaeger concrete mixer,
½-yd. Jaeger concrete bucket,
2″ Jaeger dewatering pump,
6″ Gorman-Rupp pump,
Master Concrete rubber and vibrator.

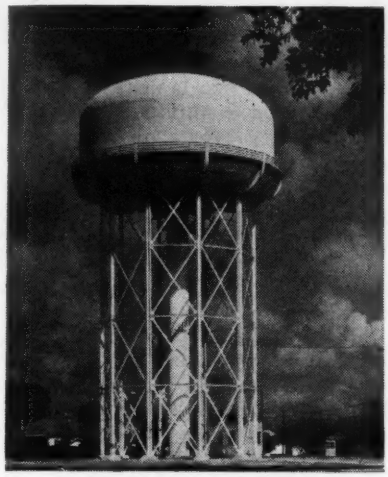
Cement was Lone Star. Structural steel, Indiana Central States Bridge Co. Reinforcing steel, Hugh J. Baker Co.

The bridge was built for the Commissioners of Hamilton Co., under the direct supervision of the writer.

Soil Compacting With Giant Rollers

The Sacramento District, Corps of Engineers, U. S. Army, has constructed a sheepsfoot roller of unusual size for compacting the soil under the runways at the Fairfield-Suisum airfield. This soil is a plastic clay having a California bearing ratio of 3%. It was desired to compact this to 8% CBR to a depth of 21 inches at one operation rather than in 6″ layers. To do this, the engineers built a sheepsfoot roller consisting of a steel drum 8 ft. in diameter and 10 ft. long, to the surface of which were welded 156 steel feet 18″ long with diamond-shaped pads 2½ x 5 in. for contact surfaces. The drawbar was attached to a rectangular box-girder frame surrounding the roller and suspended from the axle of the drum. The entire roller weighed about 27,000 lb., or 58,000 lb. when the drum was filled with water. This roller, after a reasonable number of trips, climbs out until the feet are only 6″ deep, and this top 6″ is compacted with a standard sheepsfoot roller. The surface is finished with a heavy rubber-tired roller, consisting of steel boxes carried by an axle, on each end of which is a dual wheel having two 24 x 32 in. pneumatic tires; the boxes being filled with scrap steel until the weight was as high as 170,000 lb. in one case.

Use of the giant sheepsfoot roller compacted the soil at a depth of 18-24 in. from 80% relative compaction to 95-100%, and at 12-18 in. depth from 70-80% to 90-102%, and for 6-12 in. depth from 67-72% to 82-92%. The top 6 in. was then compacted with the heavy pneumatic roller from an average of 81% to an average of 93%.



One million gallon radial cone bottom tank at Beaumont, Texas.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

Improvements in Dalecarlia Filters

Washington's Dalecarlia filters were built in 1928 with wooden slat bottoms, which were unsatisfactory and between 1939 and 1943 these were replaced with conventional pipe laterals, which greatly increased the actual capacity. In 1942, eight of the twenty filters were equipped with crushed anthrafilt of 0.65 mm effective size and Palmer rotary agitators. Started at 6 mgd, sand beds dropped to a 4 mgd rate in 50 hrs and anthrafilt beds in 98 hrs., both giving equally good effluents. The anthrafilt beds require no more wash water than the sand and run twice as long between washings. Washing a sand filter without the surface wash required 169,000 gals.; washing an anthrafilt bed required 130,000 gals. plus 8,300 for the Palmer sweeps, or 138,300 gal. total. As soon as they can be obtained, Palmer sweeps will be placed on all the remaining filters. During 2½ years that anthrafilt was used without sweeps, there was a gradual accumulation of mud and very small mud balls on the surface, which was scraped off periodically.[X2]

Tennessee Valley Health Problems

The Tennessee Valley Authority's program to transform a flowing stream into a series of lakes has resulted in many social, economic and physical changes of public health significance. About 900,000 acres of land have been acquired and about 10,000 families relocated. Among the health problems presented by this enormous project are malaria control; prevention of silicosis among workmen; regulation of recreation facilities, fishing and hunting; and water supplies and sewerage of the communities located in the valley.

Water supply structures that were flooded were adjusted or relocated. When the quality of the water was affected the remedy usually was not so simple; in some cases a complete change in the source of supply or treatment was necessary. The Tennessee Valley as a whole contains relatively clean streams. A few changes have taken place since impoundage which may have resulted in adverse local conditions, but the streams themselves are in better condition as to both quality and quantity.[A55]

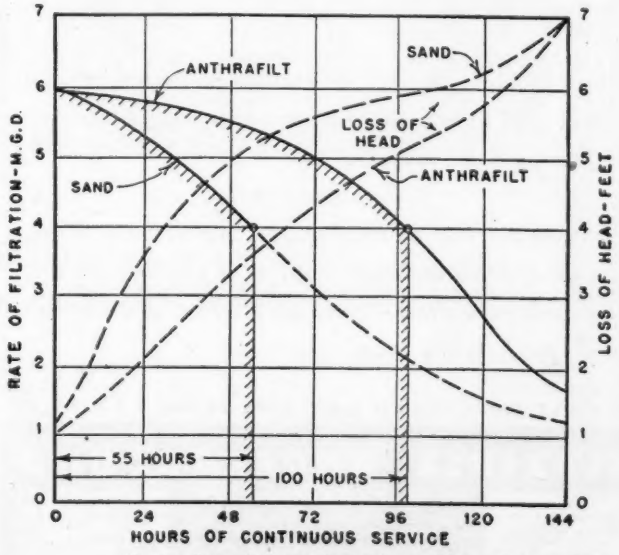
Temperature Changes Break Water Mains

Each year, with the beginning of warm weather and again with cold weather, Richmond, Va., has experienced a number of water main breaks. The temperature of the James river, the source of supply, varies approximately 50°. It is believed that this change causes the mains to expand and contract, and it is hoped to eliminate breaking from this cause by use of flexible mechanical joint pipe. The city now is using U. S. Mechanical Joint type pipe, 250 lb. class, cement-lined, emulsion-treated pipe in 18 ft. lengths. These joints permit deflection of 3° 30′ per joint. In bolting the joints, a 10″ ratchet torque socket wrench is used, set to break pull at 60 lb. While being jointed together, the pipe is laid on blocks, which are removed after the joints have been made. This permits laying in wet and muddy trenches.[A58]

Copper Sulphate Controls Bacteriological Aftergrowths

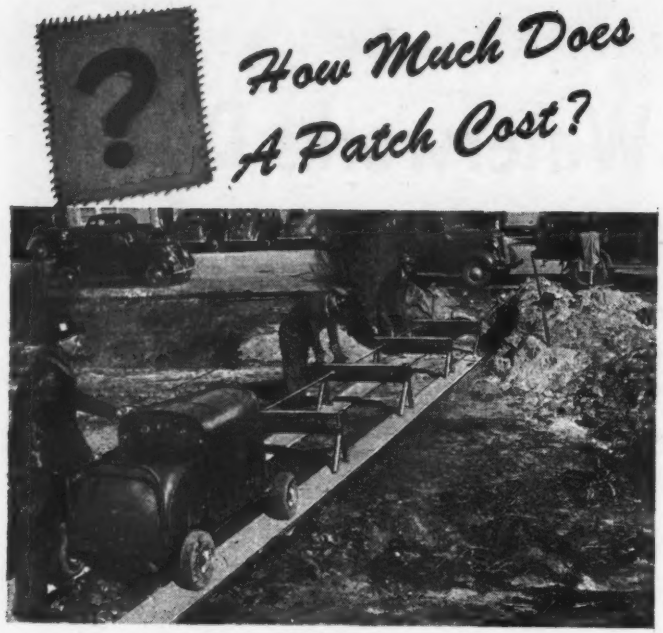
Bacteriological growths in the Champaign-Urbana distribution system became so luxuriant that the continual sloughing off caused consumer camplaint. Breakpoint chlorination would require 27 ppm of chlorine, which was considered economically unsound. Feeding copper sulfate solution into the filter effluent was tried in April, 1940, and complaints dropped at once from 66 in March to 4 in May. Later this treatment was discontinued for two weeks and the complaints increased at once. The effect of this treatment was progressive, dropping from 235 in 1941 to 110 in 1942, to 75 in 1943.

The explanation suggested is that, when copper sulfate is added following chlorination, the chlorine combines with only a part of the natural ammonia in the water, forming chloramine; then the remaining ammonia com-



Courtesy Proceedings, Maryland-Delaware Water & Sewerage Ass'n

Dalecarlia filters, May, 1944.



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bines with copper to form a copper-ammonia complex, or the chloramine combines with copper to form cupric chloramine, or both combinations may occur. It is possible that in either case the ammonia is more stable and thus is prevented from conversion to nitrites by bacteria.[A52*]

Fish Reduce Algae in Lake

Ridgefield, Conn., obtains its water supply from a lake 37 acres in area, 51 ft. max. depth, capacity 290 m.g. For years it supported heavy algae growths. Because of odor and taste caused by these, copper sulphate was applied several times a year. Formerly the lake contained bass, pickerel, bullheads and other fish, but none was noted after a dose of 900 pounds of copper sulphate was applied in March 1931. In 1940 a thousand large-mouth bass and 4,000 barred killifish were placed in the pond, and in 1942, 2500 golden shiners. Since 1940, no copper sulphate has been needed to control the algae growth.[F21*]

Big Pipe From Little Ones

WPB approved construction by Springfield, Mass., of 40,000 ft. of 52″ steel main in 1941. Soon afterward steel was "frozen," and inside of 24 hours two steel-wise men, representing the city, started for the mid-western oil fields and here and there picked up small quantities of 26″ and 36″ pipe which, together with the residual caissons on an emergency dock, furnished enough steel to build one-third of the line. Each length of pipe was cut along the longitudinal welded seam and rolled inside out, to the diameter of 59″ and 51½″ pipe, and two pieces welded together along the longitudinal edges to make a pipe, cleaned, dipped in tar, and the lengths so made were welded together in the trench. The cost was about 40% more than the original estimate for the same length of pipe. This was an auxiliary line to supplement an existing 42″ line, and increased the capacity from 22 mgd to 26.5.[F16*]

Profit Sharing By a Municipal Plant

The Waukesha Water Utility Commissioners in January 1945 adopted, for a two-year trial, a profit sharing plan by which the employees of the utility will receive as a bonus 4% of the net residual income, retroactive for 1944; the net residual being the excess after retirement expenses, local taxes and dividends on the city equity have been deducted. On the basis of previous years, this would give about $1,400 to be distributed. No bonus is to exceed $150 a year.[G8*]

Care of Water Meters

Select a meter whose maximum rated capacity is five times the estimated operating rate. Flush the service line before installing the meter. Be sure there are no pipe strains transmitted to the meter. Never put red lead or other pipe compound on the female thread—only on the male. Test all ⅝ in. meters for accuracy at ¼ gpm or less for one complete revolution of the test hand, at 2 gpm, and up to 12 gpm. In repairing meters, pay special attention to the register, the gear train, and the measuring elements. The clearance of disc or piston should not exceed 0.004 to 0.005 in. if water temperature varies widely or if the water contains sediment; otherwise the clearance should be only half this.[G10*]

Too Many Dams Planned

Draining marshes, sloughs and small lakes, which began about 60 yrs ago, hurried the rainfall to the rivers and caused disastrous floods, aggravated droughts and lowered ground water tables, ruining millions of acres of productive land. Realizing this, various agencies now propose holding back the water by means of dams. But too many

*See Bibliography in the April issue.

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dams may be just as destructive as too much drainage. It would be much preferable to store the water within the soil, thus aiding agriculture; prevent soil erosion, and reforest certain areas.

Congress is considering three wholly separate and uncoordinated programs for damming the same waters, backed respectively by the Army engineers, the Reclamation Service of the Dept. of the Interior, and the President's program for extension of the Tennessee Valley Authority principle to seven major river basins; such a duplication, overlapping and irreconciliable conflict with natural conditions as seriously to cripple each other's effectiveness. Apparently none of these proponents has considered the fact that dams built in a muddy stream will be filled with silt before they can pay for the cost of construction. No heavy silt-bearing streams should be dammed until soil erosion has been controlled effectively. A dam across the Missouri river anywhere between Sioux City and Yankton would fill with mud at the rate of 6,000,000 tons of solid matter a year. Silt deposited annually in a lake or reservoir smothers all aquatic vegetation, causing fish and migratory fowl to disappear, and makes the shores muddy and unattractive. The Army engineers propose to maintain an empty reservoir to hold back flood waters, and at the same time use it for producing electric current—two irreconcilable purposes. The only program offering a comprehensive water management mechanism is that for duplicating the TVA, but this lacks a thoroughly engineered program for erosion control. (See the article in this issue "Protecting Municipal Watersheds in the Southeastern States.")[A56]

Stream Pollution In Tennessee

A Stream Pollution Study Board, authorized by the 1943 General Assembly of Tennessee, has studied the sources of pollution and the condition of the streams of that state and recommended the establishment of a permanent stream pollution control board, with power to define what constitutes pollution and to promulgate rules and regulations to interpret and facilitate its authorized powers; with authority to investigate pollution and require its abatement, seeking injunctions when necessary; with power to review plans of new waste systems and treatment works prior to construction and to require suitable treatment; and control over the maintenance and operation of such works.

The administration of this program would be centralized in the Dept. of Public Health, which should integrate the efforts of all state and local agencies.

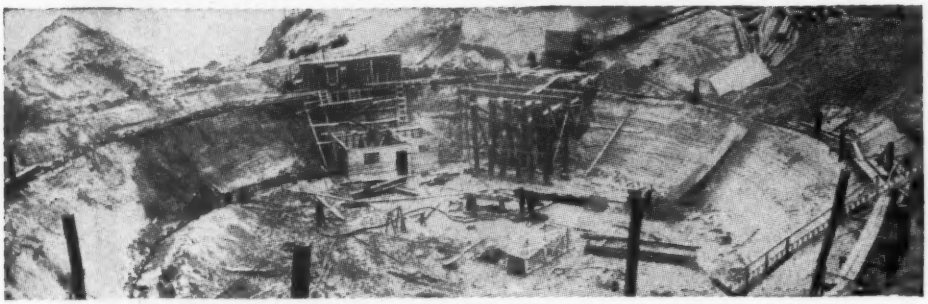
Among the objectives would be to "maintain suitable sources of public water supplies so that, with a reasonable degree of purification, a safe and satisfactory water may be provided wherever necessary for domestic and other municipal use"; also to protect and improve the waters so as to promote desirable fish and other aquatic life; to conduct a program for obtaining the treatment of municipal sewage and industrial wastes.

The investigation showed that more than 11% of the major streams are seriously or moderately polluted. Surface waters are used as sources of 56 public water supplies for nearly 600,000 people—approximately 20% of the state's population.[A57]

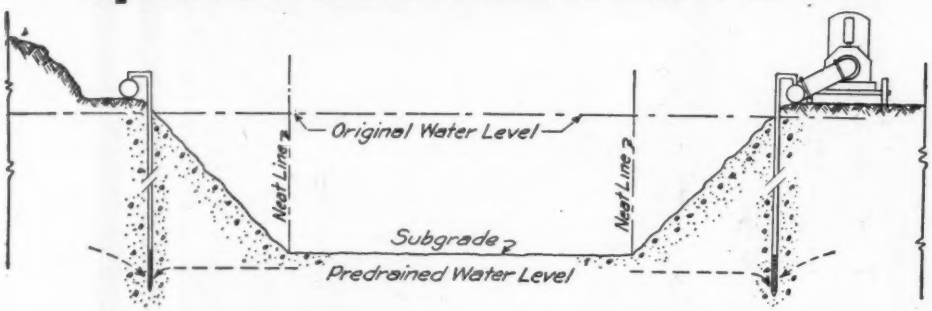
Metering in Rahway, N. J.

With its average water consumption exceeding the dry-weather flow of the river from which it is taken, and practically no storage, Rahway, N. J., found it necessary to purchase water from other communities at $167 per mil. gal. The industrial consumers and part of the commercial were metered, but all domestic service was on a flat rate basis and was estimated to average 104 gpd per capita. In 1942 and 1943 4,200 domestic meters were purchased and installed.

A Griffin Wellpoint Job!



Rapid Griffin Predraining Speeds Excavation in Sand



No Sheeting Needed on this job

This excavation for a municipal water supply was situated only a few yards from open harbor water. Sand was bulldozed across the dredged harbor to form a dike. The photo above shows the excavation 10 days after two Griffin Pumps started with Griffin Wellpoints at 4-foot intervals. Water level dropped 20 feet. Removal of water pressure allowed sand to repose naturally on a 1 to 1 slope; and excavation proceeded without delay. Dry YOUR next wet job for less—use GRIFFIN WELLPOINTS.

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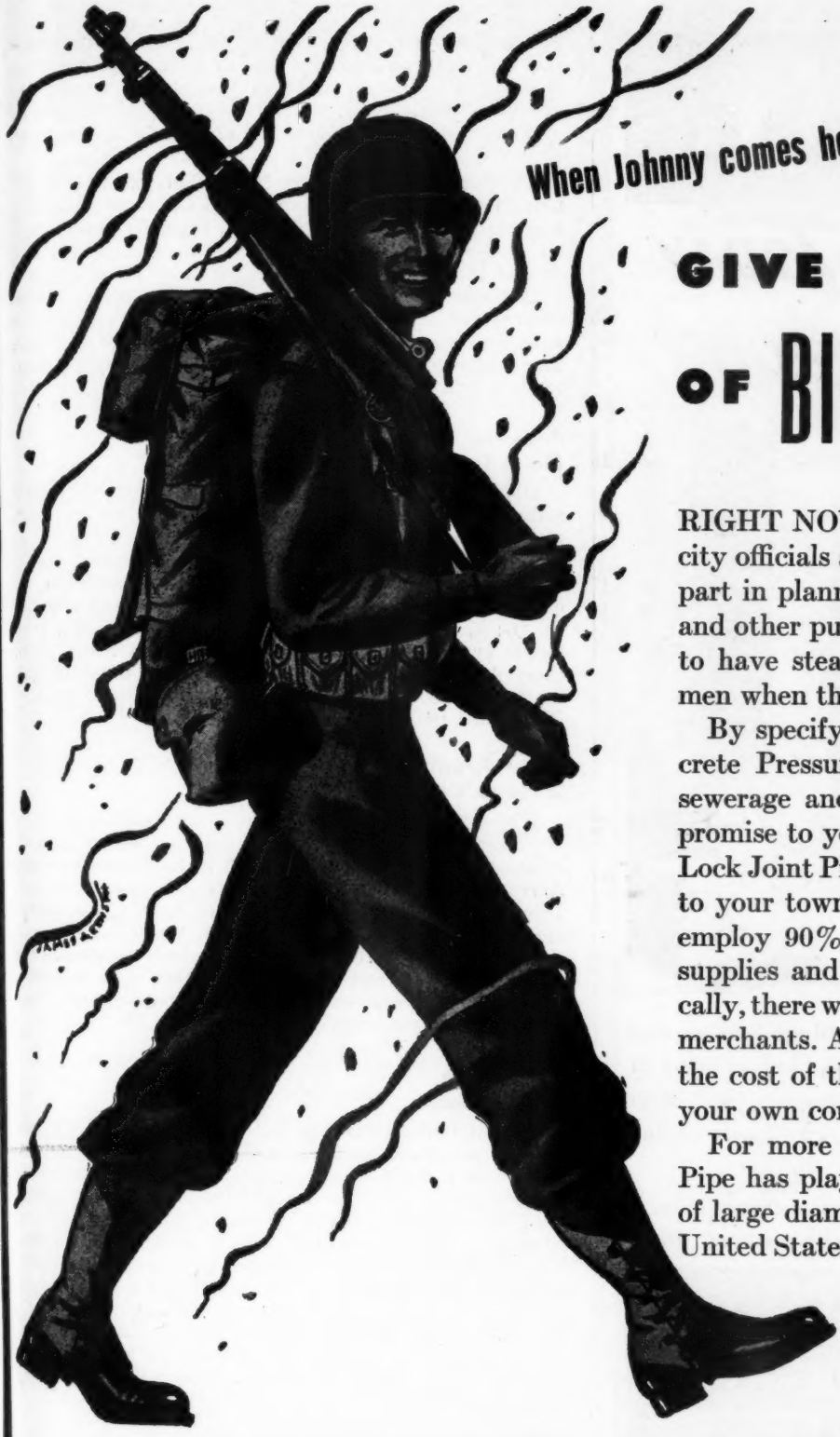

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For the four years before metering, the domestic consumption had averaged 1.88 mgd; the first year after metering it averaged 1.59 mgd, or 88 gal. per capital, a reduction of approximately 15%. Metering also reduced the average peak-hour loads from 5.9 to 5.5 mgd, and the maximum from 7.8 to 7.1. The rated filter capacity is 6 mgd.

The over-all cost of meter installation was $14.98 per unit in place; basement settings, $13.97; curb settings, $28.49. The total cost was $65,895. Figuring depreciation on a 30-yr. basis, interest at 2% (the bond rate), and cost of repairing, reading and billing at $7,000 a year (believed to be very generous), the additional annual expense due to metering was $9,939. The saving due to reduction in consumption of 106 mg per yr. was $10,123, plus $1,000 estimated reduction in cost of sewage treatment; a total saving of $1,184 per year.[A59]

Periodic Meter Testing

Oklahoma City tests and overhauls its domestic meters after 7-yr. periods of service, taking each meter apart, cleaning and reassembling it. In Haddon Heights, N. J., ⅝, ¾ and 1 in. meters are tested in 5-yr. cycles, larger meters oftener. The Illinois Commerce Commission requires testing a ⅝ in. meter every 10 yr. or every 100,000 cu. ft.; ¾ in. meters every 8 yr. or 150,000 cu. ft.; 1 in. meters every 6 yr. or 300,000 cu. ft.; and above 1 in. every 4 yr. Waukesha, Wis., has a 7 yr., 600,000 gal. limit for ⅝ in. meters. In all of these, accuracy of measuring at flow receives special attention.[A60]

Meter Repairing by St. Louis County Water Co.

When ⅝ in. and ¾ in. meters are overhauled, they are taken apart and the various units placed in allotted containers—all registers in one, all trains in another, etc. A repair man overhauls all the contents of each container at one time. After the cases have been cleaned, the meters are assembled at the assembly bench, where all repaired units are available within arm's reach. Only by chance are parts returned to the case from which they were removed. This procedure practically doubles the output over that when meters were overhauled individually.[A63]

Dredging a Settling Basin

A tidal settling basin at the Torresdale filters, Philadelphia, was built in 1916, 2,000 ft. long and 500 ft. wide, with a depth varying from 13 to 23 ft., according to the stage of the river. By 1944 sediment had accumulated reducing the effective volume to little more than ⅛ its original capacity. In September 1 to Oct. 15 of 1944, 420,000 cu. yd. of material was removed by an electrically operated suction dredge and discharged onto a low swampy area nearby. Electric operation avoided contaminatio the water in the basin by oil or gasoline, and the use of suction avoided increasing the turbidity of the water by stirring up the sediment. The cost was about 49 cts per cubic yard.[F24]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n.*
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56. Speaking of Flood Control. By J. N. Darling. Pp. 345-349.
57. Stream Pollution in Tennessee. Pp. 350-361.
58. Experiences With Mechanical Joint Pipe. By E. R. Sharp. Pp. 362-365.
59. Water Conservation in Rahway, N. J. Mortimer M. Gibbons. Pp. 366-372.
60. The Meter Department of a Water Utility. By Seth Burnley, W. B. Harman and A. T. Lundberg. Pp. 373-378.
61. Los Angeles Distribution System Flow Analysis Methods. By C. J. Itter. Pp. 379-389.

62. Design of Water Distribution Systems. By W. D. Hurst. Pp. 390-404.
63. Corner-Cutting Practices at the St. Louis County Water Co. By W. Victor Weir. Pp. 414-416.

B *Journal, New England Water Works Ass'n.*
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18. Studies of the Needham ,Mass., Distribution System. By Roger G. Oakman. Pp. 1-8.
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20. Effect of the Hurricane of 1944 on Massachusetts Water Supplies. By Francis H. Kingsbury. Pp. 13-18.
21. Effect of the Hurricane of 1944 on Rhode Island Water Supplies. By Walter J. Shea. Pp. 19-21.
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26. Survey of Interior Water Piping in Connecticut. By David C. Wiggin, Jr. Pp. 71-78.
27. Application of Oxidation Potential Measurements in Determining the Concentration of Germicidally Active Chlorine in Water. By Shih Lee Chang. Pp. 79-101.

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13. Pre-Stressed Gunite Reservoirs. By I. M. Glace. Pp. 83-86.
14. Crenothrix: Alive, Dead and Entombed. By Carl Wilson. Pp. 90-92.

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17. Corrosion of Iron by Sulfides. By Richard Pomeroy. Pp. 133-138.

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8. Ingenuity and Small Outlay Greatly Increase Dallas Water Supply. By Homer A. Hunter. Pp. 81-83.
9. Wartime Water Rates. Pp. 99, 101.

K *Proceedings, American Society of Civil Engineers*
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U *Taste and Odor Control*
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1. Practical Plankton Counting Procedures for Tennessee River Reservoir Water Supplies. By C. W. Kruse. Pp. 1-9.

V *Journal, Maine Water Utilities Ass'n*
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3. Maintenance of Meters. By J. Arthur Jackson. Pp. 29-35.

X *Proceedings, Maryland-Delaware Water & Sewerage Ass'n.*
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X *Journal, Western Society of Engineers*
March

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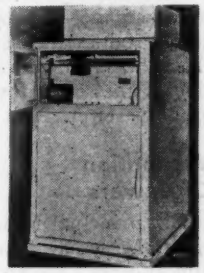

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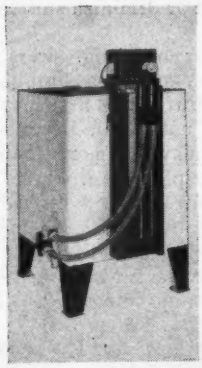

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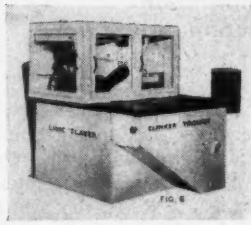

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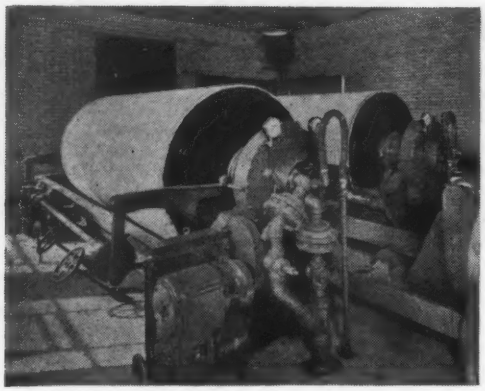


Vacuum filters at Cuyahoga Falls, Ohio.

The Sewerage Digest

Abstracts of the main features of all important articles dealing with sewerage and sewage treatment that appeared in the previous month's periodicals.

Locating Lost Sewers

In New Rochelle, N. Y., many sewers laid in private real estate developments were never mapped, or the maps were lost, and the manhole heads were buried under later roadway surfacings. The city engineer has located most of these, using the M-Scope in many cases. The sewers were generally vitrified pipe, and to furnish the metal to cause the M-Scope to operate, he inserted a flexible sewer rod in the sewer and connected the transmitter to the rod. Then with the receiving set he could follow the line of the sewer for 200 ft. of shallow sewer, or 100 ft. of deep sewer. Also it was used for locating manholes.[C33]

Ventilation Of Sewers

Six principal reasons for ventilating sewers are: 1—To eliminate lethal atmospheres. 2—To eliminate explosive atmospheres. 3—To reduce corrosion of concrete by hydrogen sulfide. 4—To prevent corrosion of plumbing in buildings by gases from the sewer. 5—To prevent escape of odors from the sewer. 6—To prevent or diminish sulfide generation in the sewage.

There are three principal methods of ventilating sewers: 1—Perforations in manhole covers. 2—Ventilation through house plumbing vents. 3—By forced draft. The first may be advantageous in some locations but not in all. Benefits from the second are not great and may be more than offset by sulfide corrosion of the house plumbing. Forced ventilation is the most effective, but its usefulness is limited by its cost, difficulty of finding suitable locations, the problem of deodorizing the exhausted air or so discharging it as will not cause a nuisance. In many sewerage systems ventilation is unnecessary, as where sulfide and explosive atmospheres are absent; and where these are present, it may be possible to prevent their formation in or entrance into the sewer.[C34]

Infiltration In Sanitary Sewers

Infiltration into sewers has been measured by the author varying from 5,500 to 1,400,000 gal. per mile per day; the former, vitrified clay pipe with bituminous joints in pervious soil, low ground water; the latter in a segment block sewer with cement mortar joints, pervious soil, high ground water. In comparing bids for laying sewers in Cranston, R. I., the probable infiltration into each of four kinds of sewer construction was estimated, the cost of pumping and treating this amount calculated and capitalized at 3% and this amount added to the bid. This capitalized cost varied from 31¢ to 97¢ per foot of sewer and made the next to the highest bid for construction seem the most economical. Use of bituminous joint compound will produce first-class, relatively water-tight joints if the surfaces of the pipes in contact therewith are thoroughly cleaned and dry before the compound is poured, if the compound is heated to the proper temperature and the inert filler not allowed to separate out while melted; if the compound is chemically inactive to acids, alkalies and other solvents in sewage, and if the joint is thoroughly filled. Properly supporting, bedding and cradling of pipe lines is very important. Leakage of storm water runoff into sanitary sewers through ordinary openings in and around manhole frames and covers does not seriously increase the sewage flow.[C35]

Biochemistry of Films of Standard and Biofilters

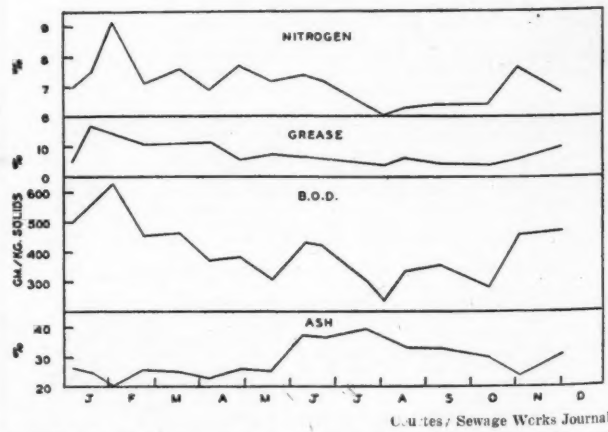
A study of the biochemical characteristics of the films at different levels in both biofilters and standard filters led to the following conclusions: There is a definite and significant increase in the stabilization of the film from both filters as revealed by increase in ash, decrease in B.O.D., and grease content in the lower levels of the bed and by the relatively greater increase in the warmer than in the colder months.

The film from both filters is characterized by an unusually high nitrogen content, the proteins alone constituting 45-50% of the solids, indicating a high photoplasmic material of the microflora and microfauna. The nitrogen content of the biofilter growth is higher than that of the standard filter and activated sludge. The B.O.D. of the biofilter film is higher than that of either of the others.

There was, in general, an inverse relationship between the ash content of the film and the B.O.D., grease and nitrogen content, the ash however increasing at a higher rate than the others decreased. The rate of oxidation of the film was of such a magnitude as to be one of the important factors limiting the quantity of the film.

Temperature and the applied load play an important role in determining the biochemical character of the film.

The chemical characteristics of the sludge collected from the secondary clarifier showed a lower degree of stabiliza-



Courtesy Sewage Works Journal

Relationship between nitrogen, grease, B.O.D. and ash contents of the film at the top two-foot level of the standard filter.

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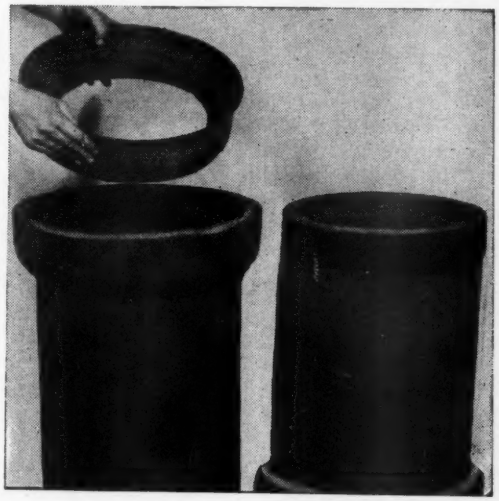
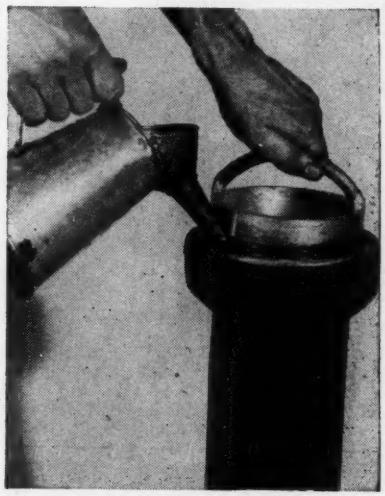


2. Our 2-in-1 die method of preparing a joint by pouring two collars at once. We have improved this operation utilizing two kinds of plastic cooperating with each other to make an effective joint eliminating necessity of freshening up the collar surface each time.



3. For domestic pipe—A simple method is shown using a removable metal form. Bell collar may be poured with either Portland cement or Para-Plastic. When Para-Plastic (which is an adhesive compound holding bond at sub zero weather) is used, it eliminates coating spigot. Pressing of units together gives firm bond.

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tion than did the film in the lower levels of the bed, indicating that at least a part of the sludge came directly from the upper levels.

The numbers of ciliates, flagellates and rhizopods were practically the same in both types of filters.

The chemical and biological characteristics of the film revealed that the difference between a biofilter and a standard filter is only quantitative. Considerable oxidation of the film took place in the biofilter, which therefore is not a mere colloider.[C37]

Treating Packinghouse Wastes

In 1943, 30,806 million pounds of animals were slaughtered in the United States, producing 50,000 million gallons of wastes, with a population equivalent of about 11,200,000 on a B.O.D. basis. The quantity of wastes per animal killed varies greatly between plants, varying, in ten plants recorded, from 835 to 4,160 gal. per 1,000 lb. of animals killed. The plant showing the minimum had produced 1,130 gal. two years previous. In general the kill during winter months is about 120% of the yearly average, and that during the summer is 90%; but in general more waste per unit of kill is produced in cold than in warm weather.

The composition of the wastes from different packinghouses varies widely, B.O.D. from 5.2 to 18.9 parts per thousand in the ten plants recorded, and suspended solids from 2.9 to 22.0. The wastes contain much grease, averaging about 7 lb. per thousand pounds of kill. The temperatures of the wastes are high, sometimes reaching 90°.[C38]

Treating Oil Wastes

In October 1944 about 4,500,000 bbl. of crude oil per day were being refined by processes that included isomerization, alkylation, catalytic cracking and other methods, each producing wastes with different characteristics. These wastes are commonly classified under the heads: Oil-field brines; free (unemulsified) oil and water; oil-water emulsions; wastes which contribute odor and taste; wastes which consume dissolved (in water) oxygen; truly toxic or poisonous wastes; acid wastes; alkaline wastes; wastes which contribute color.

Methods for treating these wastes have been and are being studied by committees of the American Petroleum Institute and various refining companies, especially the Atlantic Refining Co. The methods employed may be generally classified as disposal by controlled discharge (dilution); breaking emulsions, and further treatment for removing tastes, odors, etc. Generally an emulsion-breaking plant consists of a large tank equipped with air for agitation, heating coils, a skimming device, and an ordinary type of sand filter.[C39]

Citrus Canning Wastes

Wastes from citrus canning are of two classes—wash water from the plant, and press liquor produced by compressing the solid wastes for feed. The former is comparatively low in organic content, the oxygen consumed value being not more than 2,000 ppm, is high in carbohydrate and low in nitrogen. The press liquor contains 8 to 10% solids. The canning wastes are sometimes emptied into lakes, but if the dilution is not great enough, may kill fish by robbing the water of its oxygen and nitrogen. If mixed first with sewage, this may satisfy its demand for nitrogen and the mixture be less objectionable than either singly. At Lakeland, Fla., the sewers receive the citrus cannery wastes, the seeds and rag being kept out by fine screens, and the mixture is passed through primary sedimentation tanks, an aero-filter and secondary tanks; the B.O.D. of the effluent rises during the canning season.

Lagooning produces odor and fly nuisance. Sand filtration is a highly desirable method if there is available a

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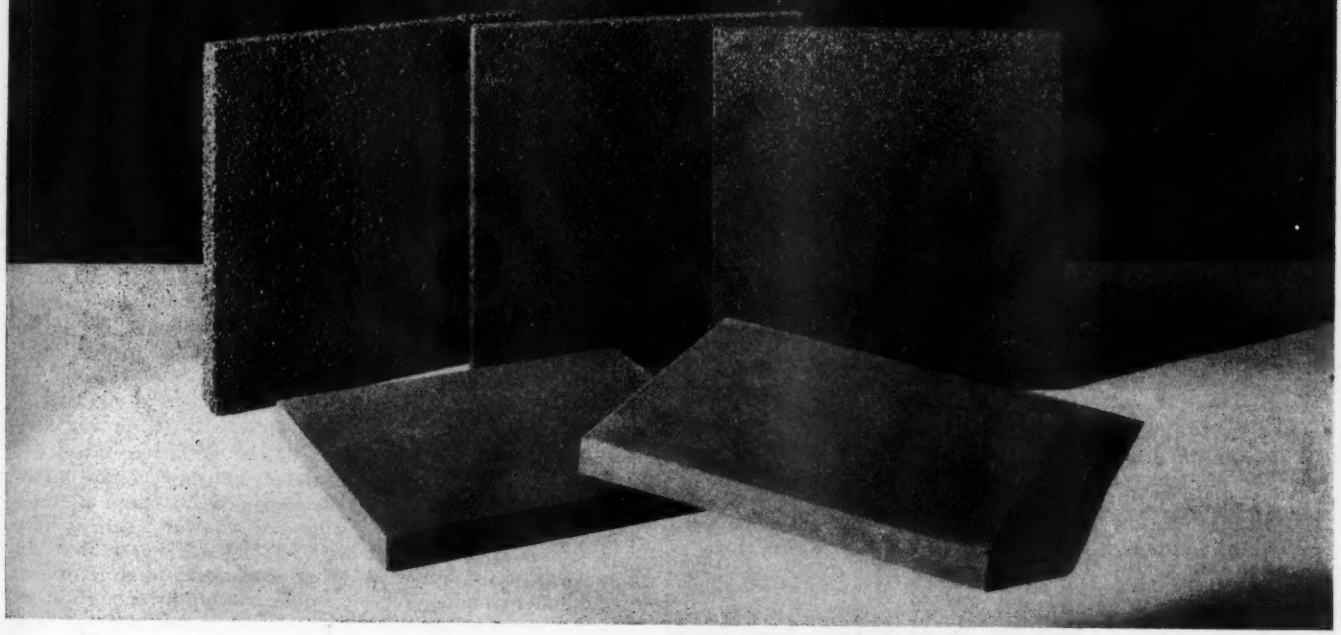

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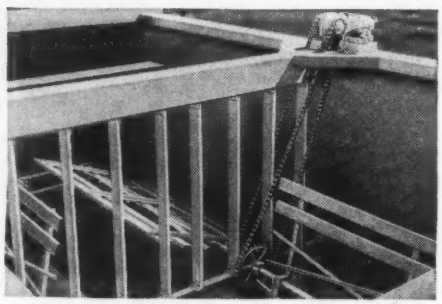
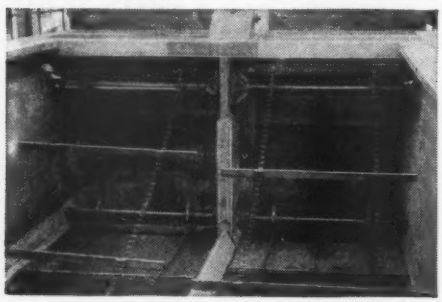


REX SLO-MIXERS—Rex Slo-mixers provide tapered mixing to promote rapid floc formation in the first stage with decreasing mixing in subsequent stages for development of a large, fast settling floc. Varying paddle speeds and varying paddle sizes or a combination of both can be provided as the conditions of design indicate. A large number of narrow blades provide ample paddle area and assure thorough mixing without setting up an undesirable motion in the water itself.



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large area of sand where the water table is sufficiently low. Press liquors have been discharged into drainage wells, but this pollutes the ground water. The organic content is too high to permit discharge into lakes. Discharge onto orange groves kills the trees. Lagooning is about the only allowable sanitary method available to most plants, but causes objectionable odors and flies. Citrus molasses and alcohol have been produced from it, with some profit under war conditions.[C40]

Grease in Camp Sewage

Army post sewages in the Third Service Command average 362 ppm B.O.D., 311 ppm suspended solids, and 6.2 ml of settleable solids per liter. (Municipal sewages run about 265, 243 and 7.2 respectively.) The low rate of settleable solids is attributed partially to grease flotation.

Water softeners have been installed in nearly all the laundries to reduce the use of soap, and the saving in soap alone has more than paid for them, with the additional benefit of lessening the grease and oil in the sewage. Gasoline used in airplane and auto repair and service shops carries grease and oil into the sewers. Wash racks are especially responsible and are connected to storm drains where possible.

Grease must be removed before it reaches the secondary treatment unit. Basket screens, skimmers and baffles are used in wet wells, trunk sewers, screen and grit chambers and in distribution channels of tanks, and the grease removed by skimming with hand tools.[X2]

Plant Effluent Used by Steel Company

The Sparrows Point plant of the Bethlehem Steel Co. uses about 170 mgd of tide water; but this contains 4,000 ppm of chloride ions, and the plant needs 50 mgd of water containing not over 175 ppm and a lower figure is very desirable. Up to December 1942 it used water from 32 artesian wells, but with increased demands of war orders, the underground reservoir would not supply enough water and other possible sources were investigated and the most promising was found to be the effluent from Baltimore's Back River sewage treatment plant 5½ miles away. Test use of this at the mills showed it to be usable and economical if reprocessed, except for the high chloride content which at times reached 600 ppm. Investigation showed that the chloride was due to infiltration of harbor water into the sewers around the harbor, which are 3 to 10 ft. below the level of mean tide. The worst infiltration points were located and infiltration decreased until the chloride content was lowered to 60-100 ppm. The activated sludge plant furnished 20 mgd of effluent which could be used without further treatment except for chlorination. The trickling filter effluent, however, had an average turbidity of 18-30 ppm, suspended solids of 25 ppm and M.O. alkalinity of 175 and required reprocessing. A plant was constructed for treating 30 mgd of trickling filter effluent, or of combined filter and activated effluent if the total requirement exceeded the latter by less than 30 mgd. Activated alum is applied at the inlet. mixed and flocculated, and the liquid settled in mechanically cleaned clarifying basins, screened to remove scum, and flows into a basin, and chlorine added to maintain 0.75 ppm residual. From here it flows by gravity through 24,000 ft. of 60" pipe to the steel plant, where it enters a 90 mg reservoir. The purpose of this reservoir is to permit eliminating high chloride peaks by shutting down the treatment plant during such peaks, and to guarantee a supply of water near the steel plant. Here a 10,000 gpm and two 15,000 gpm centrifugal pumps distribute the water under 55 lb. pressure to the various parts of the plant, including a 750,000 gal. water tower. Traveling screens and chlorinators are located at the pumping station.

The system was put into operation on December 5, 1942, and has been in continuous operation ever since, averaging over 24 mgd of effluent with the following

analysis at the steel plant: Chlorine, 0.25 ppm; chlorides, 98 ppm; turbidity, 8.0; pH, 6.9; B.O.D., 8.0 or less at pump inlet, 3.0 or less at plant. Activated alum of 16.4% alumina content is used; no lime. Pre-chlorination is used at times for reducing "gassing-up" of the sludge in the clarifiers; post-chlorination continuously to maintain a residual of 0.35 at the high-head pumping station. When necessary to control algae, the reservoir is treated with copper sulphate and chlorine. The city is paid for its plant effluent, the monthly payments being materially reduced if it is not up to the stipulated standard. In 28 months the payments totaled $30,343.[X3]

Coagulant for Vacuum Filters

The demand for coagulants in preparation for vacuum filtration varies greatly with various types of sludges in different plants; and in the same plant, filter yields are largely a function of the amount of coagulant used. If a mathematical relationship could be discovered between the quantities of chemical reagents demanded by various sludges and certain basic sludge assays, it should enable an engineer to select the most economical method of sludge processing and disposal for given local conditions, should enable the plant superintendent to determine how he can improve the economics of conditioning and filtration in his plant, and stimulate further investigation into the influence of volatile matter on coagulant demand.

The author finds that the basic factors that influence coagulant requirements in sludge conditioning are (a) The liquid demand of the chemically and biochemically contaminated water associated with the sludge solids, and (b) the demand of the wetted sludge solids themselves; the former based on the weight relationship of bicarbonate alkalinity to ferric chloride, the latter on an empirical relationship of ferric chloride to the volatile or organic portion of the sludge solids. The latter he believes to be a function of a constant (approximately 1.6) times the ratio of volatile matter to ash in sludge solids.[K2]

Removing Cyanide From Wastes

Cyanide wastes from metal finishing in an aircraft factory were so concentrated that disposal by dilution was impracticable and their effect on digestion and trickling filters might be very injurious, and a plant was designed for the complete removal of all toxic constituents by batch treatment. In this plant chemical precipitation removes toxic constituents other than cyanides; then the effluent is chlorinated and retained in a tank for 20 to 30 minutes, the chlorine reacting with the cyanides to form cyanogen chloride, which quickly hydrolyzes to ammonium carbonate, and this becomes free ammonia and carbon dioxide. The plant has for 18 months been producing an effluent free from cyanides and other toxic constituents.[G17]

Sludge Digestion At Tonawanda, N. Y.

Tonawanda operates four single-stage digesters serving 52,000 persons. Frequent analyses of digester gas show a very definite relationship between composition of gas and tendency of digestion to go into the acid range which just precedes foaming, and thus foam has been prevented entirely.

A most valuable feature of the digesters is a set of sludge samplers which permit sampling sludge at one-foot intervals for the entire depth of the tank; each pipe discharging into a trough through a quarter-turn Nordstrom valve.

Each tank has a stirring mechanism. One of these was inoperative for several weeks, and comparison of the operation of this tank with the other three tanks using stirrers showed that it is possible to reduce the volatile matter and get thicker sludge much more quickly by using the stirring mechanism 8 hrs. a day.

Raw sludge is pumped from the clarifiers to the digesters every other day instead of every day, to thicken the sludge in the clarifiers and thereby pump less liquid.[C45]

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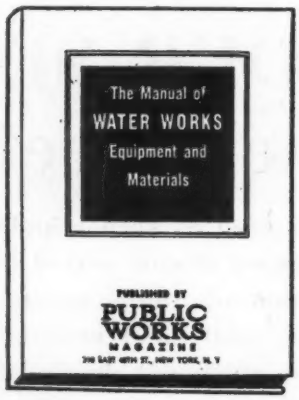


NATCO UNIFILTER TILE FOR TRICKLING FILTER SYSTEMS

Write for literature on Natco glazed segmentile for corrosion resistant walls of circular filter beds

One piece underdrain
Egg-shaped run-off
Rapid, complete ventilation
Salt glazed surfaces

NATIONAL FIREPROOFING CORP.
PITTSBURGH PA.

When writing, we will appreciate your mentioning PUBLIC WORKS

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n,* note or short article; *p,* paper before a society (complete or abstract); *t,* technical article.

C *Sewage Works Journal*

March

33. Locating Lost Sewers and Manholes. By E. T. Cranch. Pp. 199-202.
34. The Pros and Cons of Sewer Ventilation. By Richard Pomeroy. Pp. 203-208.
35. Control of Infiltration and Storm Flow in the Operation of Sewerage Systems. By Ralph W. Horne. Pp. 209-222.
36. A Critical Review of the Literature of 1944 on Sewage and Waste Treatment and Stream Pollution. By Committee on Research. Pp. 223-268.
37. The Relationship Between Accumulation, Biochemical and Biological Characteristics of Film and Purification Capacity of a Biofilter and a Standard Filter. By H. Heukelekian. Pp. 269-291.
38. Treatment of Packinghouse Wastes. By Kenneth V. Hill. Pp. 292-306.
39. Treatment of Oil Industry Wastes. By W. B. Hart. Pp. 307-319.
40. The Citrus Canning Waste Disposal Problem in Florida. By Robert S. Ingols. Pp. 320-329.
41. The Treatment of Some Chemical Industry Wastes. By Thomas Powers. Pp. 330-337.
42. Industrial Wastes in Connecticut and Their Treatment. By William S. Wise. Pp. 338-347.
43. Sewer Maintenance Planning—Records and Methods. By Reuben F. Brown. Pp. 349-357.
44. Interesting Extracts from Operation Reports. By LeRoy W. Van Kleeck. Pp. 357-367.
45. Sewage Treatment Practices at Tonawanda, N. Y. By Channel Samson. Pp. 367-372.

D *The Surveyor*

March 2

14. Sewerage and Sewage Disposal in 1944. Pp. 125-127.

March 9

15. *p.* Some Factors Influencing Sewer Design By James A. Whyte. Pp. 135-136.
16. Operation of an Enclosed Aerated Sewage Filter. Discussion. Pp. 141-142.

March 16

17. Effect of Treatment in Percolating Filters on Bacterial Count. Discussion of D4. Pp. 153-154.

E *Engineering News-Record*

March 22

4. Chicago Adopts Huge Sewer Program. Pp. 84-86.

G *Water Works and Sewerage*

March

6. Solving an Oil Waste Problem Through Industry Cooperation. By I. O. Lacy. P. 96.
7. Cyanide Removal From Metal Finishing Wastes. By Francis S. Friel and Gordon J. Wiest. Pp. 97-98.
8. Sewage Treatment Plant Design. By Thomas M. Riddick. Pp. 99-104.
9. Waste Treatment Pays in a Paper Mill. By Harry W. Gehm. Pp. 105-106.

April

10. Cathodic Protection Overcomes Operating Difficulties in Mechanical Sewage Filters. By Albert B. Kozma. Pp. 109-113.
11. *n.* Sludge Bulking Controlled by Chlorination. By Stephen R. Kin. P. 141.

H *Sewage Works Engineering*

April

21. Economics of Gas Engine Pumping With Sewage Gas as Fuel. By H. T. Rudgal. Pp. 184-187.
22. Sludge Elutriation Design. By A. L. Genter. Pp. 188-190.
23. Filter Loadings. By N. T. Veatch. Pp. 191, 210.
24. Chemical Treatment. By Francis Friel. Pp. 192, 215.

J *American City*

April

7. Sewerage and Water Systems Under Joint Management. By James W. Myers, Jr. and John W. Pray. Pp. 76-78, 105.

K *Proceedings, American Society of Civil Engineers*

March

2. Computing Coagulant Requirements in Sludge Conditioning. By A. L. Genter. Pp. 307-330.

April

3. Sedimentation and the Design of Settling Tanks. By Thomas R. Camp. Pp. 445-486.

M *Water and Sewage*

March

9. Winter Repairs to Leaking Sewer. By W. B. Redfern. Pp. 26, 48.

P *Public Works*

April

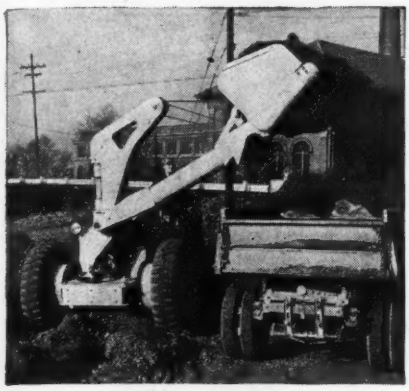
15. Hazards in Sewage Works Operation. Pp. 17-18, 52.
16. A Sewer Laid Through a Swamp on Timber Grillage. By Don D. Williams. Pp. 23-24.
17. *n.* Sanitary Equipment in Mexico. P. 24.
18. Fertilizer From Twin Cities' Sludge. Pp. 28, 54.

X *Proceedings, Maryland-Delaware Water & Sewerage Ass'n.*

Year of 1944

2. Some Observations on Grease in Sewage at Army Camps. By A. E. McCasky. Pp. 29-35.
3. Industry Cooperates With a Municipality in Solving a Wartime Industrial Waterworks Demand. By William P. Hill. Pp. 72-94.

Keeping Up With New Equipment



Jaeger "Fleetfoot Loader."

The "Fleetfoot Loader"

Jaeger Machine Co.
400 Dublin Ave., Columbus 16, Ohio

This "Fleetfoot" Loader, developed by the Jaeger Machine Company, is equipped with 180° swinging boom which enables it to load trucks from either side without need for backing and turning the entire machine. Crowding, hoisting, swinging and dumping are accomplished in one rapid, continuous movement. Power controlled buckets enable operator to control dumping as desired and to close bucket while it is being returned to loading position. Two speeds for boom operation are available, independent of traction.

As no maneuvering is required, the machine can work close alongside trucks in alleys or crowded spaces. The swinging boom also enables it to dig outside its wheels when used as an excavator.

With 65 h.p. gas or diesel engine, front wheel drive through big pneumatic-tired wheels which carry 80% of the load, and low gear traction speed of ¾ m.p.h., crowding power is ample to load any material, do grading, backfilling and light excavating work and serve as a prime mover for trucks and freight cars. Six forward and six reverse travel speeds up to 15 m.p.h. enable the machine to travel to and from the job under its own power, and operate over a wide area. Vickers power steering is standard. This mobility and the use of quickly interchangeable buckets of ½ to 2 cu. yd.-size, enable a single machine to handle a wide range of work and material for contractors, municipalities, counties and state highway departments, ranging from stone, earth, brick and coal to snow and cinders and from digging, loading and leveling to clean-up work and emergency service on washouts and landslides.

With crane booms of up to 25 ft. length, which can be installed as an attachment, the same machine is also used for pipe laying, form handling, pole setting and light steel erection. Cable controlled blade for light bulldozing can also be furnished.

The machine was originally developed for the U. S. Navy and large industrial war plants where many are now in use. Complete catalog describing the "Fleetfoot" Loader may be obtained by writing the Jaeger Machine Company, or from any Jaeger distributor..

Multi-Feature Cable Controlled Bulldozers

Baker Mfg. Co.
Springfield, Ill.

Over twenty years ago, Baker engineers designed and built its first successful hydraulic bulldozer.

Now, after nearly a quarter-century of building earth moving equipment and experimenting and study, Baker is introducing a line of Cable Controlled Bulldozers and Gradebuilders and Power Control Units made exclusively for Allis-Chalmers HD-14, HD-10 and HD-low Tractors.

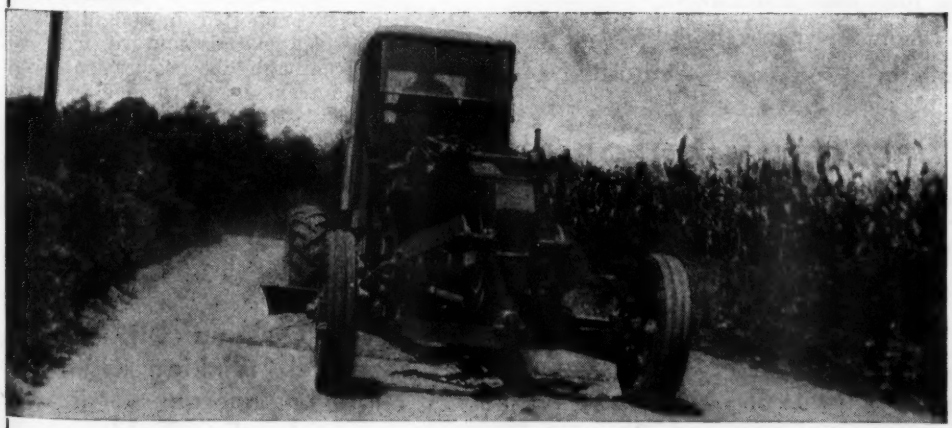
Features include: Sturdy, reinforced

WARCO MOTOR GRADERS

For all-around work—Heavy Construction, Banksloping, Ditching, Blacktop, Maintenance—they'll give you economical and lasting service. All this—

plus

Powerful medium and heavyweight Chain Driven Tandem Drives, whose power wheels assure *positive* traction under extremely adverse conditions. WARCOS stay on the job through toughest going, with enough power to whip the most discouraging and seemingly impossible obstacles!

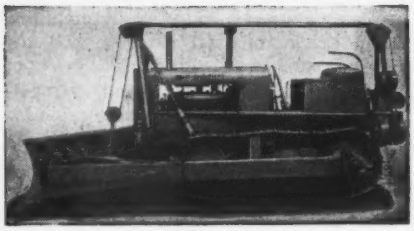


Easy Hydromotor Control of all blade movements. Instantly available power in hydraulic lines. Such positive and exact blade control that follow-up work is practically eliminated.

Bulletin No. 4300

W. A. RIDDELL CORPORATION, Bucyrus, Ohio

When you need special information—consult the classified READER'S SERVICE DEPT., *pages 97-99*

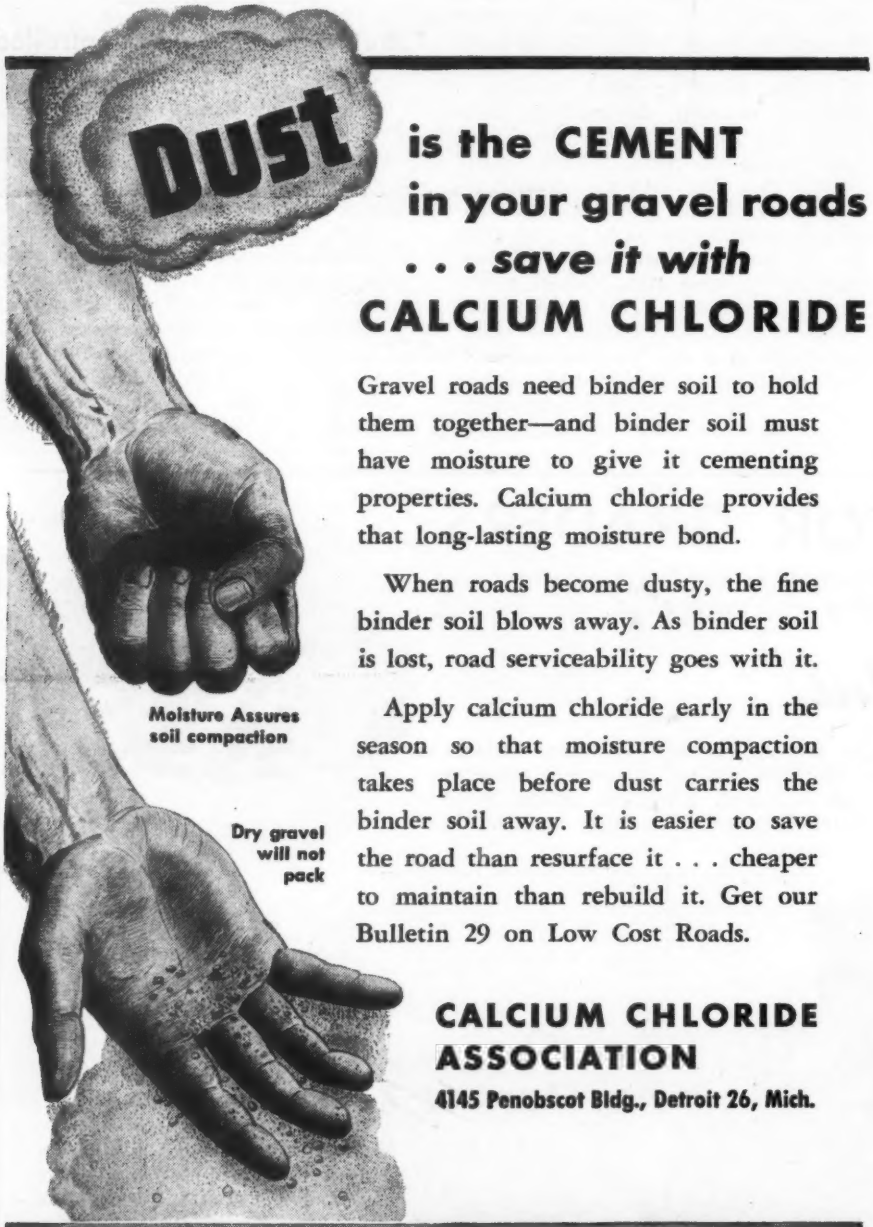


Baker Cable Controlled Bulldozer.

tubular arch; rugged constructed box-welded moldboard; 5-position side arms which permit tilting of blade up to 10" on the Bulldozer and 12" on the Gradebuilder from a perpendicular position; 42" blade lift above ground on Bulldozer, 50" on Gradebuilder; blade drop below ground level limited only by length of cable.

The Power Control Units feature differential or self-energizing brakes whereby the dead end load assists the spring in setting the brake and is arranged so that the differential factor increases as band lining wears. Less pressure is required on hand lever in releasing brake; "air-conditioned" cone type clutches and band brakes are employed; brakes have 3" bands; all adjustments made from rear-easy to get at; drum barrel has curved contour at anchor end of drum which assists rope to wind closely at start of winding. Power Control Units are made in heavy duty double drum and single drum types for rear mounting, double and single drum medium duty units for HD-7 Tractors and a single drum front mounting type for HD-14 and HD-10 Tractors.

A bulletin gives complete specifications and pictures the complete Cable Controlled Line. Copies will be sent upon request to Baker Mfg. Co.



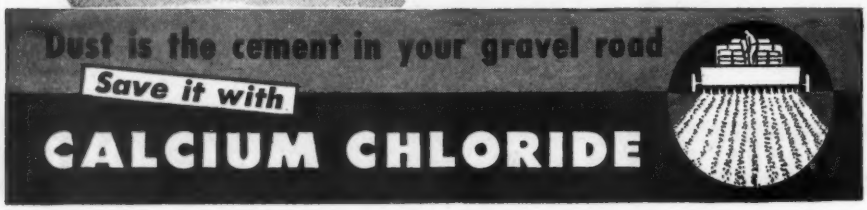
Dust is the CEMENT in your gravel roads . . . *save it with* CALCIUM CHLORIDE

Gravel roads need binder soil to hold them together—and binder soil must have moisture to give it cementing properties. Calcium chloride provides that long-lasting moisture bond.

When roads become dusty, the fine binder soil blows away. As binder soil is lost, road serviceability goes with it.

Apply calcium chloride early in the season so that moisture compaction takes place before dust carries the binder soil away. It is easier to save the road than resurface it . . . cheaper to maintain than rebuild it. Get our Bulletin 29 on Low Cost Roads.

CALCIUM CHLORIDE ASSOCIATION
4145 Penobscot Bldg., Detroit 26, Mich.



Yeomans Bilge Pump.

Improved Bilge Pump Design

Yeomans Bros. Co.
1433 N. Dayton St.
Chicago 22, Ill.

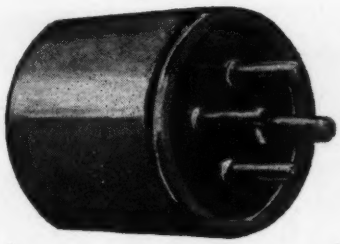
The Yeomans Series 3000 bilge pump is furnished as a unit, consisting of the pump casing, impeller, shaft, suspension and discharge pipes, thrust bearing and flexible coupling, factory assembled on a suspension plate with a catch basin or sump cover, together with motor and automatic control equipment. Cast-iron or steel basins and curb rings are available as optional equipment.

Pump casing of this Yeomans unit is the submerged type and is equipped with an enclosed type hydraulically balanced impeller, all of cast-iron. It is hung from the suspension plate by a wrought steel suspension pipe which encloses the pump shaft. In addition the pump is supported by the discharge pipe which extends upward from the pump through the suspension plate. With duplex sets the pumps are hung from individual suspension plates mounted on the main catch-basin cover. One pump may be removed without disturbing the other.

Complete description of the improved Bilge Pump is given in Bulletin 3003. Write Yeomans Bros. for a copy.

Reco "On and Off" Flasher Operates Blinking Lights at Night on Emergency Airplane Landing Fields

The new Reco Thermo Flasher No. 4188 operating a magnetic relay and lamps, makes it possible to mark the boundaries of an emergency airplane



Reco Thermo Flasher.

landing field at night with lamps flashing "On and Off."

The unit is built to withstand considerable abuse. It can be dropped to the ground from a great height under severe and varied conditions of weather and temperature and continue to function.

The new Reco Thermo Flasher is supplied in a cylindrical metal container 1½" diameter by 1¼" long. Complete flasher weighs approximately two ounces. It is made with a standard four prong base for quick and easy replacement in radio type socket. Under normal conditions the unit will start flashing at 110 volts in from three to five seconds.

Complete information can be obtained by writing the Reynolds Electric Company, 2650 W. Congress St., Chicago 12, Illinois.

Concrete Batching Plant

C. S. Johnson Co.
Champaign, Ill.

Specifications reveal a 5 cubic yard truck receiving hopper and a 90-ton per hour aggregate elevator. Total bin capacity is 45 tons, in 3 compartments arranged for two truck loads in each compartment. The Porto Batcher batches into truck mixers, stationary mixers or paver batch trucks. One man control of all batching operation is provided by centralized grouping of controls.

For the use of contractors and engineers who require fast, accurate batching at the construction site this plant was developed. Originally designed as a complete portable highway batching plant, the Porto Batcher is widely used as an auxiliary plant for a variety of construction projects.

The Johnson "Porto Batcher's" skip allows full use of mixer capacity by providing complete intermingling of aggregates with cement when discharged into mixer.

The Porto Batcher may quickly and easily be towed from job to job by an ordinary truck. Erection is simple. It operates on any level area near the pouring site. It is unnecessary to dig pits or construct a foundation. Likewise, no crane is required for handling the aggregates nor for setting up the plant.

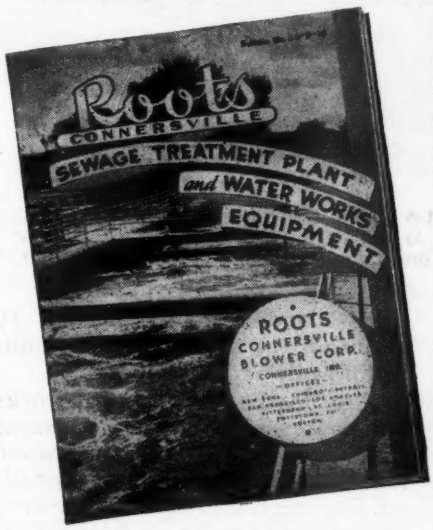
Plant receives aggregates by truck. Bulk cement can be handled direct from hopper bottom railway cars, or bag cement may be weighed into batch hopper from overhead cement compartment.

Photo shows 3 "R-C" Multi-Capacity Blowers. Capacities of each unit 583/1166/1750 CFM, at 6 to 7 lbs. pressure.

The Roots-Connersville Multi-Capacity Blower is one of the most effective means of obtaining an air supply flexible and adequate enough to meet varying conditions.

The blower chamber is divided into two sections of different widths. Each represents a separate rotary positive blower, but for *economy, compactness,* and *convenience,* both sets of impellers are assembled in one case and carried on the same shafts and bearings.

When the two bypass valves are closed, the capacity of both sections is delivered into the line. With either one of the valves open, that section is by-passed to the suction without compression. This by-passing takes negligible power — only 1% to 2% of the total. Thus, with one unit, driven by one constant speed motor, it is possible to obtain at high economy three different capacities. Let us figure on your post-war requirements.



BULLETIN 23-B-12

— will aid correct planning and specifying. It gives much interesting and helpful data on aerating blowers, digester gas meters, and filter vacuum pumps. A copy of this Bulletin will be mailed on request.

ROOTS-CONNERSVILLE BLOWER CORPORATION
ONE OF THE DRESSER INDUSTRIES
505 Valley Ave., Connersville, Ind.

WRITE FOR BULLETIN 23-B-12

Roots CONNERSVILLE SINCE 1854 Aerating BLOWERS

When you need special information—consult the classified **READER'S SERVICE DEPT.,** *pages 97-99*

Poly Phosphate Comparator

W. A. Taylor & Co.
7300 York Rd., Baltimore 4, Md.

Low concentrations of the poly (glassy) phosphates, such as hexameta, pyro, septa, etc. (threshold treatment) are coming into more and more general use. They are employed in power plants and hot water systems to prevent feed line deposition; in air conditioning and refrigeration units, laundries, dish washers, milk handling equipment, etc., to prevent deposition and corrosion; in municipal and process waters to stabilize the water and prevent corrosion (red water). A simple, rapid and accurate method of analysis is therefore imperative.

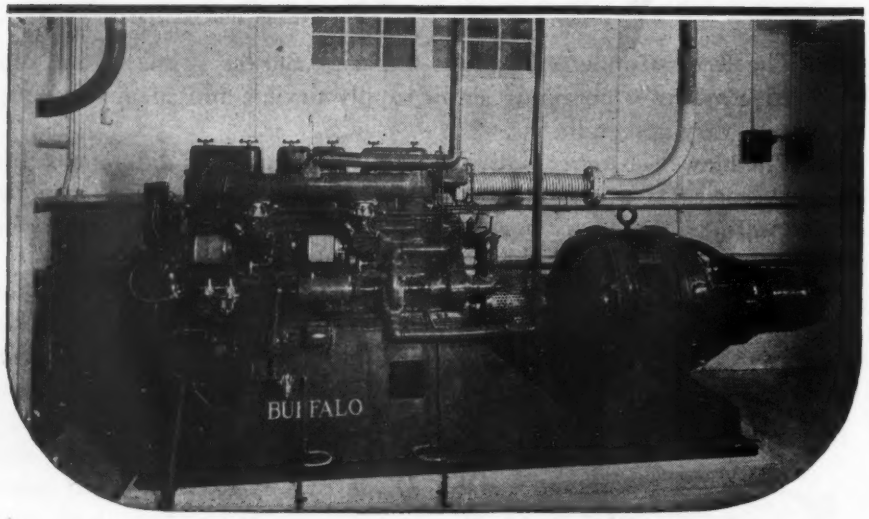
The Taylor Poly Phosphate Comparator, developed by W. A. Taylor & Co., is ideal for this purpose. Previous methods required several hours boiling to convert the glassy phosphates to the ortho form. By the Taylor method a complete determination requires only 20 minutes. After conversion, two reagents are added separately and the blue color formed is compared with the standards. This gives the total phosphate content. A determination on the cold sample (no boiling) gives the ortho present in the sample. The difference is the poly phosphate.

The outfit consists of a comparison block containing 8 standards, 0, 0.5, 1, 2, 4, 6, 8, 10 ppm, 2 comparison tubes, funnel, filter paper, graduate, flask and reagents. All equipment is contained in a wooden carrying case 9¼ in. long, 6¼ in. wide and 9 in. high.

Taylor Poly Phosphate Comparator.

Quick Starting EVERY TIME

BUFFALO ENGINES — ASSURANCE of PROTECTION



Radio Station WBAL, Baltimore. An RA-6 Engine Generator Unit. Engine 6 cyls., 5⅛" bore, 7" stroke, direct connected to 100 K.W., 1200 RPM Westinghouse generator. Fully automatic stop-start on failure of main source of current.

RADIO stations and fire protection systems both install emergency power equipment, but while, with good fortune, a fire system may never need stand-by power, the nature of radio means that its engines are cut in with some frequency.

It's a pleasure to hear, as we do, from radio station managers that their BUFFALO ENGINES never fail to give them power with the split-second response needed to maintain the stop-watch continuity of radio programming.

Fire, flood control, sewage works and water works have the same assurance of protection when BUFFALO ENGINES are installed. Engineers and others interested are invited to write for BUFFALO ENGINE specifications and data on the design and installation of stand-by equipment.

BUFFALO GASOLENE MOTOR COMPANY
DEPT. PW-55 BUFFALO 13, N. Y., U. S. A.

BUFFALO ENGINES — ASSURANCE of PROTECTION

BUFFALO ENGINES — 100 H. P. THROUGH 750 H. P.— IN GENERATOR AND PUMPING SETS FOR WATER WORKS — AIRPORTS — COMMUNICATIONS — FLOOD CONTROL — HOSPITALS — INSTITUTIONS — MINES — MOVABLE BRIDGES — THEATRES — SEWAGE PLANTS.

When writing, we will appreciate your mentioning **PUBLIC WORKS**

NEW CATALOGS

Below are described the latest catalogs received by PUBLIC WORKS. All are available free on request to the manufacturers whose names are given.

Floatless Liquid Level and Industrial Controls

B/W Controller Corp., 2200 East Maple Rd., Birmingham, Mich., publishes a 30 page catalog describing all electric floatless controls adapted for use on all pumps, sewage ejectors, deep well-cut-offs, etc. Diagrams showing dimensions of enclosures and details for wiring application, etc., are included.

DeLaval Steam Turbines

DeLaval Steam Turbine Co., Clinton 2, N. J., has issued a new 24 page bulletin describing in detail its line of water works and sewage pumps.

A section of the bulletin is devoted to descriptions of blowers and compressors. DeLaval Steam Turbine Co. was founded in 1901 and has pioneered in the development and specialized in the production of steam turbines for nearly half a century.

Incinerators of Every Type and for Every Purpose

Morse Boulger Destructor Company, 205-P, East 42nd Street, New York 17, N. Y., issues an eight page, well illustrated folder in which all types of incinerators for municipalities, institutions and private dwellings are described. The capacities of the incinerators furnished by this company range from 50 lbs. per hour to hundreds of tons per day. When you are interested in incinerators you should have this folder.

Gas and Gasoline Engines for Flood Protection

Buffalo Gasoline Motor Co., 1290-91 Niagara Street, Buffalo 13, N. Y., describes and illustrates Gas and Gasoline Engines which furnish power for driv-

ing pumps for use in flood control systems.

Descriptions are given of installations in the Connecticut Valley region and by the Tennessee Valley authority. It is said that due to the partially-completed Connecticut Valley systems an estimated damage of $12,000 due to the September 1938 flood was averted, and had the works been constructed before the flood of 1927, $70,000 would have been saved.

A New Folder on Flo-Watch

Builders - Providence, Inc., Providence 1, R. I., describes and illustrates Builders Flo-watch in a new 8 page folder. The Flo-watch is a precision instrument that can render invaluable aid in the efficient distribution and use of liquids, steam, air and gas. It measures the flow through standard differential producers such as Venturi tubes, Nozzles, and Orifices. The manufacturers say it is a worthy companion of the well-known type M Register-Indicator-Recorder and Builders Chronoflo Telemeter.

Excavating Equipment and the War

"In War and Peace" is the title of a new booklet containing dramatic photographs of dozers, scrapers, dozershovels, and other tractor equipment in action on both the war and home fronts. Just published by Bucyrus-Erie Company, South Milwaukee, Wisconsin, this handsome 34-page brochure presents graphic proof that In War and Peace progress starts with excavation.

The booklet gives a vivid picture of dirt-moving machinery as an essential weapon of war. It tells how with their tractor equipment the Allies could build airports overnight, which the enemy could not do because he had failed to realize the importance of this equipment as an Engineer Corps essential.

"In War and Peace" points out that the war jobs performed by tractor equipment are basically the same as peacetime jobs. Copies of brochure may be secured by writing to Bucyrus-Erie Co., South Milwaukee, Wis.

Lubricated Plug Valves

A new folder describes the distinguishing features which are claimed to be, among other things—straight full pipe—area port opening, no change of direction of the flow, quick operating, moving full from full open to full closed or vice versa with ¼ turn. Many other interesting and new principles in the design of valves are described in the folder. Write American Car & Foundry Co., 50 Church St., New York 8, N. Y., for a copy of "A.C.F. Full Pipe-Area Plug Valves."

Positive Displacement Blowers Explained

The principle of operation and the design and construction features of Pottstown rotary positive displacement type blowers and exhausters are pictured and described in a new 16-page bulletin.

This type of unit is designed for services where volume of air or gas discharged must remain constant under variations in pressure or vacuum. Such services include agitation of liquids, air blast cleaning, pneumatic conveying, sewage disposal.

The bulletin is profusely illustrated with sectional drawings and views of parts showing the design and construction of these units, also photographs of the many types of drive and arrangement which are available. Also included in the bulletin are tables of capacity for both blowers and exhausters, and technical data which will be found helpful in the selection of a suitable unit for a desired service.

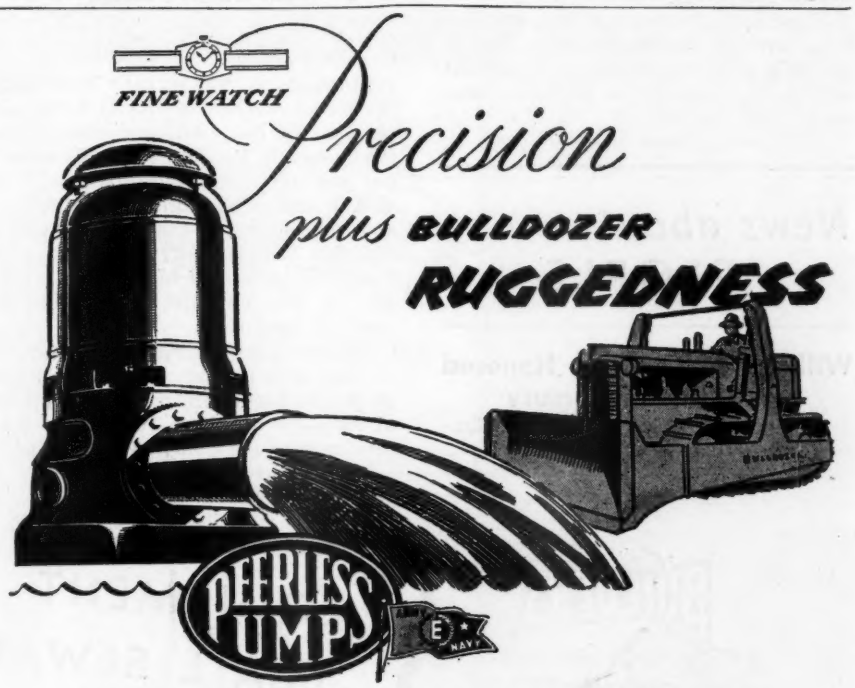
Copies of this informative bulletin—No. P100—are obtainable on request to Pottstown Blower Co., Division of Allen Billmyre Company, 431 Fayette Avenue, Mamaroneck, N. Y.

Surfacing With Tarmac

Koppers Company
Koppers Building
Pittsburgh, Pa.

Fourteen types of paving treatment are described in a new 16-page brochure.

Advantages of each type of treatment are discussed together with methods of application and tables showing Tarmac and standard road tar designa-



MORE THAN DOUBLE PUMP LIFE

Building sustained efficiency into the mechanical structure of a quently are the lowest known.

Peerless engineering is *precision engineering* that permits *closer tolerances* which eliminate the customary vibration to an unusual degree. Thus, wear and tear are reduced; repair bills consequently are the best known.

The most vital parts of a Peerless Pump are *doubly* protected . . . by a *Double Seal* and *Double Bearings* . . . plus rugged construction . . . that more than double the productive life of the pump.

***"Torture-chamber"* tests in the Peerless hydro-mechanical laboratory disclose that the Peerless-featured, fully-enclosed impellers are little affected by sand-cutting and cavitation.**

Capacities — 10 to 220,000 gallons per minute
PEERLESS DISTRIBUTORS AND DIRECT FACTORY REPRESENTATIVES ARE LOCATED IN EVERY STATE.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
Food Machinery Corporation

TURBINE
HI-LIFT
HYDRO-FOIL

301 W. Ave. 26, Los Angeles 31, Calif. • 1250 Camden Ave. S.W., Canton 6, Ohio • Other Factories: San Jose 5, Fresno 16, Calif.

tions, applications, temperatures and uses as well as recommended aggregate gradation.

Among the methods discussed is the soil stabilized base course which is used where there is a scarcity of suitable aggregate for standard types of construction and when the cost of importing aggregate is excessive.

The double surface treatment with cold and hot applications is described. Here the prime coat penetrates the road and forms a bond, while the second application holds the covering material and builds up a wearing surface.

Road repairs are given considerable attention in the booklet due to the large amount of this work that must be done as the result of wartime restrictions and lack of manpower.

Discussed also are: Prime coating, drag leveling course, mulch treatment, E-Z mix, road mixes, retreatments and seal coats, penetration macadam and hot-lay tar concrete.

News about PEOPLE

William J. Orchard Honored on 30th Anniversary

William J. Orchard, General Manager of Wallace & Tiernan Co., Inc., Newark, N. J., was signally honored by his fellow workers on April 16th—the occasion of his 30th anniversary with the company. In addition to the numerous messages of congratulations from W & T offices throughout the country and the beautiful baskets of flowers, Mr. M. F. Tiernan, President of the Company, presented his 30-year service pin to Mr. Orchard, before the assembled employees.

William J. Orchard on his 30th anniversary with Wallace & Tiernan.

Mr. Orchard became the 5th member of The W & T Diamond Club to attain 30 years of service. This club, composed of members who have 10 years or more service with the Company, presented to Mr. Orchard a solid gold cigarette lighter, suitably engraved, to commemorate the occasion.

Oechsle Vice President in Charge of Sales for Ransome Machinery Co.

Carl F. Oechsle has been appointed Vice-President in Charge of Sales of Ransome Machinery Company of Dunellen, New Jersey, a subsidiary of Worthington Pump and Machinery Corporation. The sale of Ransome's line of contractors' mixers and pavers will now be handled through Worthington's Construction Equipment Department, of which Mr. Oechsle is manager. A Booklet mentions several other pieces of equipment being made by Ransome. Headquarters of this sales department still remains in Holyoke, Mass., with regional offices in New York, Washington, Cleveland, Chicago and San Francisco.

C. H. Worrells Becomes Sales Manager of Anthony Co.

With the resignation of R. R. Howard as Vice President and General Sales Manager of Anthony Company, Streator, Illinois, Mr. Worrells, who for many years has been Treasurer of the Company, now takes over the duties of General Sales Manager.

Mr. Worrells has been with Anthony Company for twenty years.

Glenn A. Duis, for many years a consultant and director of Anthony Company, has been elected Executive Vice

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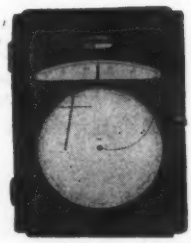

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Sincerely, BUILDERS-PROVIDENCE

When you need special information—consult the classified READER'S SERVICE DEPT., *pages 97-99*

President of the Company and takes over supervision of the operative duties of the Company's President.

Mark B. Owen Joins a Consulting Engineering Co.

Mr. Owen has resigned as director, Committee on Postwar Construction, American Society of Civil Engineers, to become a partner May 1 in the Russell B. Moore Co., consulting engineers, Indianapolis, Ind.

Prior to his service with the postwar committee, Mr. Owen had for seven years been executive in charge of engineering design and sales of all municipal equipment in North and South America for a New York corporation producing municipal and industrial furnaces and incinerators. Previously he had served for seven years as commissioner of public works and engineering for the City of Dearborn, Mich., moving up to this position after two years as assistant city engineer. His municipal service followed several years' work with Hubbell, Roth and Clark, consulting engineers, Detroit, for whom he had acted as resident engineer.

Mr. Owen is a member of the American Society of Civil Engineers and a past-president of the American Public Works Association. His experience provides a useful background for the work on which he will be engaged as a partner in the Russell B. Moore Co., a firm which specializes in waterworks, sewerage, sewage treatment, refuse disposal, airports and airport facilities, street improvements and highway bridges and grade separations.

Henry J. Sullivan Made Division Engineer for Consolidated F.W.A. Districts

Major General Philip B. Fleming, Federal Works Administrator, announces consolidation of the Richmond, Va., and Washington Metropolitan area offices of the FWA Bureau of Community Facilities.

The new area, Division No. 2, embraces Virginia, West Virginia, Maryland, Delaware, Pennsylvania and the Washington Metropolitan area. The consolidation was made to effect economies in administration and will result in the headquarters of the new division being more centrally located.

Henry J. Sullivan, who has directed FWA community works and services programs in the District of Columbia, Maryland and Virginia since May 1942, will be in charge of the division as division engineer with headquarters in the Lemon Building, 1729 New York Avenue, Northwest, Washington, D. C.

Mr. Sullivan is a native of Boston and a graduate of Harvard College. He joined the Public Works Administration in 1933, and later was assistant director of engineering and associate director of the Power Division of PWA before joining the FWA. He is a member of the American Society of Civil Engineers and the Society of American Military Engineers.

Fairbanks-Morse Employees Receive Over Three-Quarters of Million Dollars in Annual Profit-Sharing Fund

Officials of Fairbanks, Morse & Co., Chicago, have announced that over three-quarters of a million dollars have been set aside out of 1944 profits to be distributed to eligible employees, under the Company's profit-sharing plan which has been in vogue for a number of years. The exact amount so set aside totalled $776,880.16.

"1944 has been a year of accomplishment," said Colonel Morse. "We have taken two great forward steps—establishment of the Diesel Locomotive Division and the acquisition of the Pomona Pump Company."

"A small number of locomotives were built during the year with government permission and they are now giving excellent service in railroad operations. We feel that this is a forward step in our program to make use of our increased capacity for the production of Diesel Engines. We also feel that we are making an important contribution toward solution of postwar employment problems."

A. D. Camp to Foreign Sales Division of The Dorr Company

Mr. Camp has been assigned by The Dorr Company to its Foreign Sales Division.

The announcement states that Mr. Camp's new duties will make fuller use

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Remove the nozzle-cap . . . couple-up the hose . . . turn the operating-nut. Lives hang by a thread in all these operations. And in Mathews hydrants, the threads, whether standard or specially made for your needs, are designed and manufactured for dependability. For more than seventy years, every feature of the Mathews design, from operating-nut shield at top to bronze elbow-bushing at bottom, has been consistently developed and improved. Today, more than 400,000 Mathews hydrants in all climates and countries testify to the reliability of the design, the correctness of the manufacture. For long life, low maintenance, and for quick, sure operation when lives depend upon it, specify Mathews for your community.
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CONSULTING ENGINEERS

(Continued from page 92)

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An organization of 30 chemists and engineers having laboratories for bacteriology, analyses, research and Physical testing rendering
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HENRY W. TAYLOR
Consulting Engineer
Post War Planning
11 Park Place New York 7, N. Y.

of his broad knowledge of company activities acquired as manager of The Dorr Company's Technical Data Division and as advertising manager.

Chain Belt Appointments

Chain Belt Company of Milwaukee has appointed the Martin Machinery and Supply Company, 700 Dale Avenue, Knoxville, Tenn., as distributors of the complete line of Rex Construction Machinery in that area.

The Rex line which Martin will distribute includes mixers, plaster mixers, pumps, Moto-Mixers, pavers and Pumpcrete—the pump that pumps concrete.

The Martin Machinery and Supply Company also represents Austin-Western; Blockner Pumps; C. H. & E. Manufacturing Company; Le Roi Compressors and Linn Manufacturing Company.

Counselman in New Dorr Post

T. B. Counselman has been appointed by The Dorr Company to head the firm's Contract Engineering Division, with headquarters in New York. He will be in charge of the negotiation of contracts and orders for research, development, pilot plant tests, plant and process engineering and design.

Mr. Counselman comes to his new duties from The Dorr Company's Chicago offices, where he had been manager of the Industrial Division since 1928.

Charles Harding Eastwood

The entire water works industry lost an esteemed friend when Charles H. Eastwood, General Advertising Manager of Wallace & Tiernan and Associated Companies, Newark, N. J., died Friday, April 27, 1945, in the Huntington Hospital, Pasadena, California, after a relapse from a heart attack that he suffered six weeks ago.

Charlie Eastwood was born and educated in England; came to Canada with his family as a young man. He enlisted and served overseas in a medical unit of the Canadian Army in World War I, serving with distinction and receiving many honors, about which he never spoke. He joined the Wallace & Tiernan organization on March 1, 1924, confining his early work to our flour milling activities. He became Manager of the W&T District Office at Jacksonville, Florida, and in 1929 was transferred to the Head Office in Belleville, N. J., working at first on Export Sales before being assigned to responsibility for advertising and sales promotion, finally becoming General Advertising Manager.

Charlie Eastwood was blessed with a very keen analytical brain. He had an extremely high sense of loyalty to his organization and to those with whom he was associated. He was forward-looking, progressive and supremely confident, despite the serious illnesses that had been his during the past few years. Last fall he was transferred temporarily to California. His health noticeably improved until six weeks ago when he had another serious heart attack.

His wife, Mrs. Eleanore Fox Eastwood, was with him in Pasadena. He

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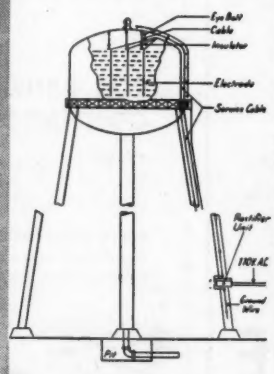

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BLADES
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CUTTING EDGES
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SCARIFIER TEETH

50 years of manufacturing blades has developed for you a special steel, milled through our own rolls and forged at the edges to give that extra wearing quality you need.

All widths lengths, and thicknesses, punched ready to fit your machine.

Consult your internationally recognized Blade Specialists. Write for special bulletins, giving type and name of machines you operate—get set for Blades early.

Shunk
MANUFACTURING COMPANY
Established 1854
BUCYRUS, OHIO.

is also survived by his mother, father and sister—all of Victoria, British Columbia.

He was a member of the American Water Works Association and the American Public Health Association for many years.

J. D. Grothe to Manage New Dorr Company Division

J. D. Grothe has been appointed by The Dorr Company to head its newly-created Technical Division of The Sales Department.

The new division co-ordinates contract engineering orders and serves in a technical advisory capacity to the Company's field staff divisions.

Mr. Grothe previously held executive posts with The Dorr Company in London, Paris, and The Hague. He has designed and supervised construction of metallurgical plants in Yugoslavia, Roumania, Cyprus and Bulgaria. In 1937 Mr. Grothe was a member of a mission sent by the Turkish government to the Taurus Mountains in Asia Minor to report on gold, silver and lead deposits there, and to advise on plant design and operational techniques.

Peerless Pumps Awarded Army and Navy "E"

To the pump industry's war record add a new Army-Navy "E" award for production excellence to Peerless Pump Division of Food Machinery Corp. Peerless' Los Angeles plant has received its second award of an "E" star for six months more of production excellence. Large shipments of Peerless Pumps have been made overseas and to army posts. Parts for the famous amphibious "Water Buffalo" are also produced.

N. B. Graham Joins Graver Tank & Mfg. Co., Inc.

Mr. Graham was formerly Vice President in charge of industrial sales for Elgin Water Softener Co., and recently became associated with Graver Tank & Mfg. Co., Inc., in charge of Water Treating and Process Equipment sales in the Tampa, Fla., area. Mr. Graham brings to the Graver organization an outstanding 20-year record of accomplishment in the water treating field and is widely considered as an authority on the subject. He will make his headquarters at Tampa, Florida.

New Distributors for Littleford Bros., Inc.

The following distributors will handle the complete line of Littleford Black Top Road Maintenance and Construction Equipment: Edward R. Bacon Co., 2101 Folsom St., San Francisco 10, Calif.; Carroll-Edwards & Co., Richmond & McLean Sts., Cincinnati, Ohio; Hardin and Coggins, 1717 N. Second St., Albuquerque, N. M.; Milton-Hale Machinery Co., 1024 North Broadway, Albany, New York; State Equipment Company, P. O. Box 668, Harrisburg, Pa.; Gibbs-Cook Tractor & Equipment Co., 1314 Walnut St., Des Moines 9,

(Continued on page 98)

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Why not incorporate the Aerofilter in your Post War Sewage Plants?

It embodies the features of all other types plus better momentary distribution.

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Do you want improved clarification, including excellent skimming and oil removal?

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TYPE "A" DAYTON-DOWD CENTRIFUGAL PUMP

- WATERWORKS
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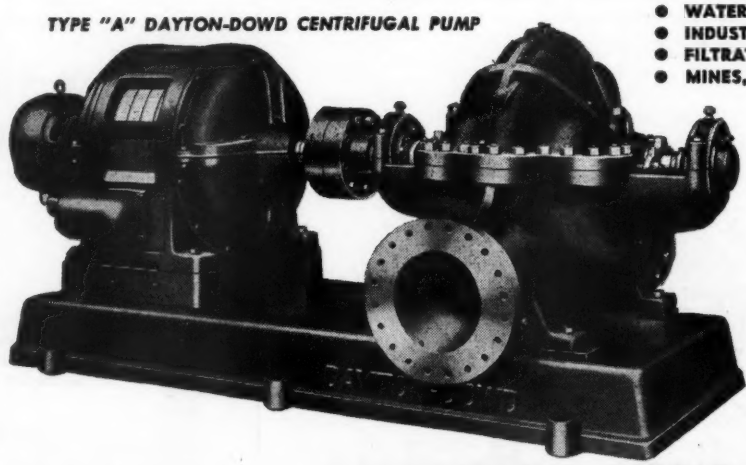

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TYPES — Single stage, single suction, sizes 2" and 3". Single stage, double suction, sizes 2½" to 42". Capacities up to 60,000 G.P.M.

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FREE CATALOG. Write on your business letterhead for interesting FREE catalog. Address: DAYTON-DOWD Company, Dept. P-15, Quincy, Illinois.

DAYTON-DOWD
Turbine Pumps • Centrifugal Pumps

438. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., 400 Chestnut St., Philadelphia 5, Pa.

439. McWane Precaulked Joint Cast Iron Pipe, in all sizes from 1¼ through 12 inches for water and sewerage, equipped with various type of factory-made joints, as well as B. & S. joints. Illustrated booklet issued by McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe Forms

440. Making concrete pipe on the job to give employment at home is the subject of a booklet by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints, Water

441. Bellmaster Joints for simpler, faster, easier joining of cast iron pipe are illustrated in a new folder that gives full data on this self-contained mechanical joint. Write Dresser Mfg. Co., Bradford, Pa.

Pipe, Lock Joint

442. Lock Joint Reinforced Concrete Sewer Pipe, Pressure Pipe, Culvert Pipe, Centrifugal Pipe and Subaqueous Pipe is described and illustrated in bulletins available from Lock Joint Pipe Co., Ampere, N. J.

Pipe Pusher

444. One-man-operated Hydraulic Pipe Pusher pushes pipe through ground under streets, sidewalks, lawns and other obstacles. Pays for itself in man hours saved on first few jobs. For complete facts and prices, ask for booklet S-117. Greenlee Tool Co., 2042 Columbia Ave., Rockford, Ill.

Pipe, Transite

445. Two new illustrated booklets, "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., 22 East 40th St., New York 16, N. Y.

Pipe Joints, Sewer

447. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Adams, Mass.

448. Asphaltic Sewer Jointing materials are described and instructions for using them are included in a folder. Premoulded Sewer Pipe Belt, a modern method of jointing, a faster installation on the job, and Tufflex, a cold trowelling plastic for Sewer Pipe joints are the products. Write Servicised Products Corp., 6051 W. 65 St., Chicago 38, Ill.

Pipe Joint Compounds

450. The uses of Tegul-Mineralead for bell and spigot pipe and G-K Sewer joint compound are described in a 16-page illustrated booklet issued by Atlas Mineral Products Co., Mertztown, Pa. Includes useful tables for estimating quantities needed.

Pumps, Sludge

451. Carter Sludge Pumps are described in 8-page illustrated bulletin, including specifications and tables. Address: Ralph B. Carter Co., Hackensack, N. J.

452. Non-clogging, vertical or horizontal, dry pit or submerged; storm water and drainage pumps are described in several Bulletins; also sump and bilge pumps. Dayton-Dowd Co., Quincy, Ill.

Pumps and Well Water Systems

454. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Advertising Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis 8, Tenn.

455. Peerless pumps in a variety of types, with oil or water lubrication and any power drive, to pump water from any depth are described and illustrated in new literature that clearly shows their construction and special features. Write Peerless Pump Div., Food Machinery Corp., 301 W Ave. at 26th St., Los Angeles 31, Calif.

456. Oil lubricated turbine pumps with open impellers. Five types of heads available. Specifications and illustrations in new bulletin 6930M-2 issued by Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill.

457. Centrifugal Pumps of various designs—single-stage, double-suction, split casing; single-stage single-suction; two-stage opposed impeller; three-stage; high-pressure; fire pumps; close-coupled. A bulletin for each type. Dayton-Dowd Co., Quincy, Ill.

Screens

460. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia 40, Pa.

Sludge Drying and Incineration

462. "Disposal of Community Refuse by Incineration" is a handsome 34-page booklet that discusses incineration from a commonsense standpoint. Illustrated by numerous photos of typical installations and includes diagrammatic outlines of various plant designs. Write Morse Boulger Destructor Co., 207-P East 42nd St., New York 17, N. Y.

463. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Plainfield National Bank Bldg., Plainfield, N. J.

Softening

466. This folder explains the process of Zeolite water softening and describes and illustrates the full line of equipment for that purpose made by the Graver Tank & Mfg. Co., 332 So. Michigan Ave., Chicago 4, Ill. Includes flow charts, tables and other valuable data. Write for a copy of this instructive folder.

467. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in a teohnical booklet. Permutit Co., 330 W. 42nd St., New York 18, N. Y.

468. Infilco Accelerators for softening, clarifying and stabilizing. Write today for bulletin 1824. Infilco, Inc., 325 West 25th Pl., Chicago 16, Ill.

Sprinkling Filters

469. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago 13, Ill.

Stand-by Motors

471. Buffalo stand-by motors for generators or pumping units are covered in illustrated specification sheets sent promptly by Buffalo Gasolene Motor Co., Dept. PW, Buffalo 3, N. Y.

Swimming Pools

474. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Taste and Odor Control

476. "Taste and Odor Control in Water Purification" is an excellent 92-page, illustrated booklet covering sources of taste and odor pollution in water supplies and outlining the various methods of treatment now in use. Every water works department should have a copy. Write Industrial Chemical Sales Div., 230 Park Ave., New York 17, N. Y.

477. Technical pub. No. 207 issued by Wallace & Tiernan Co., Inc., Newark 1, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination, a method of discovering the point at which many causes of taste may be removed by chlorination with little or no increase in residual chlorine. Sent free to any operator requesting it.

Treatment

479. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago 13, Ill.

480. New booklet (No. 1642) on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures; drawings of installations, sanitary engineering data and design details. Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia 40, Pa.

481. New 16-page illustrated catalog No. 1742 on Straightline Collectors for the efficient, continuous removal of sludge from rectangular tanks at sewerage and water plants. Contains layout drawings, installation pictures and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia 40, Pa.

482. "Sedimentation with Dorr Clarifiers" is a complete 36-page illustrated catalog with useful design data. Ask The Dorr Company, 570 Lexington Ave., New York 22, N. Y.

483. A combination mechanical clarifier and mechanical digester. The Dorr Clarigester is explained and illustrated in a bulletin issued by The Dorr Company, 570 Lexington Ave., New York 22, N. Y.

485. New illustrated folder on Straightline apparatus for the removal and washing of grit and detritus from rectangular grit chambers. Address: Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia 40, Pa.

488. "Packaged" Sewage Treatment Plants, specifically developed for small communities—100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2438 Wolfram St., Chicago 18, Ill.

491. Small type Conveyor Sludge Collector and Skimmer, Grit Collector, Aero-Filter and other equipment for small sewage treatment plants are described and illustrated in bulletins available from Chain-Belt Co., 1722 West Bruce St., Milwaukee 4, Wis.

Underdrains, Trickling Filter

492. Illustrated bulletin describes the Natco Unifilter block of glazed, hard burned clay for underdraining filter beds. Write National Fireproofing Corp., Pittsburgh 12, Pa., for free copy.

Valves (See Gates, Air Release, etc.)

Waste Elimination

493. Full information on the Pitometer Survey—a complete check-up on your water plant to reveal hidden sources of waste—will be sent promptly by The Pitometer Co., 48 Church St., New York 7, N. Y.

Water Treatment

494. New special folders contain the latest information on High Test Calcium Hypochlorite, Caustic Soda, Soda Ash, or Chloride of Lime as manufactured by Hood Chemical Co., 1819 Broadway, New York 23, N. Y. Write for desired folders, or use coupon in this section.

495. If you have a water conditioning problem of any kind, write Graver Tank & Mfg. Co., 332 So. Michigan Ave., Chicago 4, Ill., who manufacture all types of conditioning equipment and will be pleased to make recommendations.

496. "Use of copper sulphate in water treatment plants" titles informative booklet, with valuable data on chemicals, dosage, etc. Write Tennessee Corporation, Atlanta 1, Ga.

497. Ferri-floc Ferric Sulphate—a new, valuable booklet on coagulation for water and sewage treatment plants. Write Tennessee Corporation, Atlanta 1, Ga.

498. Bulletin describes stabilizing lime-softened water by recarbonation, discussing gas production, washing, compressing, drying, and applying the CO(2). Infilco, Inc., 325 West 25th Place, Chicago 16, Ill.

499. "Important Factors in Coagulation" is an excellent review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Stuart-Brumley Corp., 516 No. Charles St., Baltimore, Md.

500. Samples and technical data about Volclay, a colloidal bentonite, with high floc-forming and absorptive qualities will be sent on request to American Colloid Co., 363 West Superior St., Chicago, Ill. Effective over a wider pH range than most others.

501. "Hypo-Chlorination of Water" is a complete reference manual on the use of high-test calcium hypochlorite in the modern practice of safeguarding water supplies. 80 pages, fully illustrated; simple; non-technical. Write The Mathieson Alkali Works, Inc., 60 East 42nd St., New York 17, N. Y.

Water Service Devices

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., will be sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

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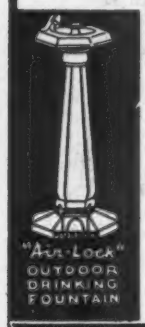
"Repairs" on MURDOCK Outdoor Water Service Devices are few and far between.



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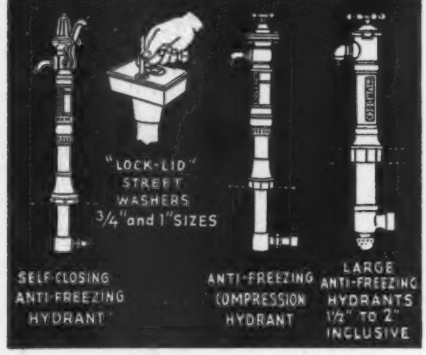

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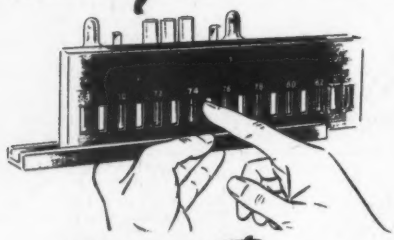

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Iowa; Indiana Equipment Co., Inc., 327 W. Market St., Indianapolis 4, Ind.; Miller G. Williams Machinery Co., Foot of Coosa St., Montgomery, Ala.; Noble-Belisle Machinery, Inc., P. O. Box 391, White River Junction, Vt.; Wolverine Tractor & Equipment Co., 35 E. 7 Mile Road, Detroit 3, Mich.; and Tractor & Equipment Co., Sidney, Montana.

Howard F. Peckworth Becomes Managing Director, The American Concrete Pipe Association

Effective April 1st Howard F. Peckworth became Managing Director of the American Concrete Pipe Association with offices in the Builders Building in Chicago. Mr. Peckworth comes to his new job from the position of Assistant to the Secretary of The American Society of Civil Engineers.

He was successively Editor of "Civil Engineering" and Assistant to the Secretary. While in this latter position he visited and spoke before groups of engineers in all parts of the country.

T. J. Kauer was appointed Assistant Managing Director of the American Concrete Pipe Association. Mr. Kauer has been Assistant to the President and Washington Representative of that Association and will continue his office in the Munsey Building, Washington, D.C.

A New Company Formed in Waco, Texas, for Selling Water Works Supplies

George J. Rohan, for twelve years Superintendent of the Waco City Water Works, Waco, Texas, has resigned and now heads The Rohan Co. of Waco, Texas, distributors of Water Works and Municipal Supplies.

Rohan has been active in the American Water Works Association for many years, having served as Chairman of the Southwest Section in 1934, and as A. W. W. A. Director from 1939 to 1942. For the past three years he has been Secretary of the Southwest Section.

Rohan's Company is distributor in the Southwest for the Rensselaer Valve Company, Hydraulic Development Corporation, Hays Manufacturing Co., along with a number of other nationally known Water Works Supply manufacturers, and will also represent the National Water Main Cleaning Company in the same area.

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